IMPERIAL BUREAU OF MYCOLOGY

The Gardens' Bulletin

STRAITS SETTLEMENTS

Vol. II Issued April 12th, 1920. No. 7

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To be purchased at the Botanic Gardens, Singapore

Printed at the Methodist Publishing House, Singapore.

THE

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The Oil Palm (Elaeis guineensis,) in the East.

The thoughts of planters and capitalists have been turning for some time to *Elaeis guineensis,* the West African Oil-palm, as a new source of supply for oil, which as we see from the Market Reports is more and more in demand, at prices, which, high as they are, are not unlikely to soar much higher in future. An increased demand for seeds of *Elaeis* is an indication that the idea of establishing plantations of the palm is taking concrete shape in the minds of many, and this has induced the present writer, as far as his limited means of information allows him to visualise it, to work out for himself the problem of the future of *Elaeis* as a planting proposition on systematic lines.

With a view to establishing a nursery in the Economic Gardens, a look-out was kept for a bunch of fruit which had shown signs of approaching ripeness for some time. The tree, which bore it, is a well-grown palm measuring no more than 7 feet to the lowest row of branches, and with a girth, at one foot from the ground of 9 feet 10 inches, and 7 feet 2″ at five feet from the ground. These measurements include the protuberances due to stumps of decayed or cut leaves. No records are to be found of the date of its plantation, but a foreman-gardener who has been working for seven years in the gardens, remembers it as a seedling when he first came. This is the first head of fruit which the tree has yet produced and this fact allows us to compute its age as somewhere between 8 and 9 years, for the habit of *Elaeis guineensis* is at first, to bring forth male flowers only, the female flowers appearing a long time afterwards. Owing to the neglected state in which it had grown, all covered, as is the wont of *Elaeis guineensis* in similar conditions, with a heavy vegetation of ferns and other epiphytic plants, we may well allow a couple of year's delay in the appearance of the male flowers which one expects on a plantation, to come out in the fourth year, and also subsequently, in the appearance of the female flowers.

Neglect notwithstanding, the tree has, as already said, grown into a fine and vigorous specimen of its kind, with a profusion of leaves from 16 to 18 feet long, and an abundance of dead and

living male flowers, the dead forming by their decay, masses of a humus-like material which fills the cavities between the trunk and the bases of the leaves. These rich humus-pockets probably explain the tendency of foreign plants to seek sustenance on *Elaeis guineensis;* the strangest of all these being seedlings of *Elaeis* itself, of which the writer found two with well developed roots and plumules embedded in the leaf-base cavities.

It will be understood that this, being the first bunch collected off the tree, it cannot in any way be an indication of the fruiting capacity of the tree, no more than the first bunch plucked off a coconut tree can be considered as an indication of its future crop capacity.

The arrangement of the leaves round the trunk of the palm is in groups of three as shown in the diagram.

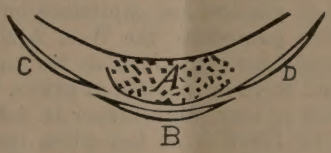


Diagram showing disposition of leaves and fruit bunch.

The bunch of fruit A is jammed between the trunk and the base of the leaf B, while the two leaves C and D also exert a pressure on the sides of the bunch. The pressure exercised by these three leaves against the bunch is very great, so much so that a large number of the fruit cannot develop beyond the embryonic stage and are absolutely wasted. Owing to this pressure, it is impossible to get at the bunches without first cutting the leaves as near as possible to their base. Now, the substance of the *Elaeis* leaf bases, is not, like that of coconut leaves, soft and yielding, it is woody and very tough, and it requires a sharp and heavy parang or a hatchet, or a chisel and mallet, to hack through it.

A point which also impresses itself very quickly on the coolie is the presence of spines at the lower end and on both sides of the stalks of the leaves (the midribs) : this makes it almost impossible for the hand of the coolie to get in touch with the bunch itself without getting hurt by the spines; and, lastly the fruit themselves are encased between spiny bracts, which put out of the question all possibility of picking them out individually by hand. It is thus seen that the fruit bunch is extremely well protected against human intrusion.

It was necessary to go into the above details to explain one of the difficulties, and not a mean one, that confronts the planter of *Elaeis*. For we may take it for granted that *Elaeis* will grow in these countries as well as in its African home, the superb specimens of the tree seen in Sumatra and in Malaya are a sure warrant of that. That it will yield as good returns and yields of oil may also be conceded. But to conclude from this, that the systematic plantation of *Elaeis* will be a "paying" proposition in Malaya or Sumatra is somewhat premature.

This is evidently not the view of a contributor to the "*Bulletin de l' Association des Planteurs de Caoutchouc*" of November 1919 who writes, page 91, "It is to be observed that the cultivation of the palm (*Elaeis*) is appreciably easier than that of *Hevea,* for the fruit is obtained by mere picking, and the question does not arise, as it does in the case of *Hevea,* whether the yield is premature or too heavy."

We think this writer attempts to prove too much. The word "cueillette" literally means "picking" and is applied to a gooseberry, an apple, or a papaya, but there is no picking the fruit of *Elaeis guineensis;* it is sheer hard whacking that does it and the following account is intended to prove it.

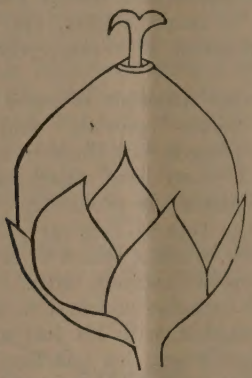
At 7.45 a.m. on the 10th of February, the present writer started work with one coolie to cut a bunch of fruit, at 8 feet from the ground on the previously described tree.

The spines on the branches had first to be pared with a parang, the man supporting himself, with his feet on the stumps of leaves which had been previously cut, his left hand holding on to a leaf above him, whilst the right hand was kept hacking with a parang at the leaf immediately below the bunch. At 8 o'clock exactly, the leaf fell, bringing down with it a lot of decayed matter, and at that moment, a great number of ants appeared, compelling the man to jump down. A ladder was sent for, and by 8.10 o'clock the man was able to resume his work by cutting the two leaves, one on the right, and the other on the left side of the bunch, and this took another seven minutes. Access to the bunch was now free, and after eight minutes more of hacking at the tough and thick peduncle, the bunch, severed at last from the tree, fell to the ground. It was then 8.25 o'clock, so that the actual time it took to bring the bunch down was from 7.45 to 8.25, *i.e.* (less 10 minutes of interruption) exactly half-an-hour.

At the store, the bunch was found to weigh 18 lbs., and with its 3 inches of peduncle, it measured 18 inches in length and it was about one foot in diameter. One side of it had only a few fully-developed fruit.

As far as the writer is aware, the only way to deal with the bunch is to lay it on its side and, with a sharp parang or an axe, to split it longitudinally in two halves, then laying each half on its flat side (the side just cut), to split it also in two. We thus have 4 quarters from which it is, comparatively, easy to dig out or pull out or wrench out by torsion, the fruit from the spiny bracts which hold them, a work which took 10 minutes to effect. The result was 206 fully-developed fruit, weighing altogether 7 lbs. In the bunch were also found a large number of misshapped and undeveloped fruit, the size and shape of a clove of garlic or even smaller, the result of incomplete fertilisation, or of compression in the bunch by the leaf at the axil of which the bunch is formed. Such fruit cannot be dealt with by any hand process which the writer can conceive. Whether they have any oil in them, and whether they can be dealt with mechanically, so as to pay costs by the extracted oil, he has no means of judging, but he is inclined

to think not. Thirty-five fruits more, of half normal size were dug-out of the bunch and, when stripped of the calyx-leaves and their peduncle cut off, were found to weigh altogether 4 ozs.



Size and shape of fruit of "Elaeis" with calyx leaves and dry stigma on top—Weight 17 grammes.

The largest of the 206 fruit is here represented in shape and size, but they were mostly of less symetrical shape, with depressions on one side and a more conical apex.

Their colour was bright orange at the base shading abruptly into deep purple and almost black at the apex.

So far the labour employed on these 7 lbs. 4 ozs. of fruit had taken 45 minutes, but it should be borne in mind that it was performed under the writer's own supervision and in his presence, without the loss of one minute, and, secondly that the tree was a very low one, the fruit being only 8 feet from the ground.

Further still, no time was put down for transport which is a larger question than appears at first sight. Dealing with coconuts, the crop of nuts can be hurled towards the transporting cart or wagon, by successive throws of 20 to 30 yards at a time, or more if the ground is a sloping one, and the job of loading is an easy one and quickly done, but with the hedgehog-like bunches of *Elaeis*, each bunch must be handled by hand, and gingerly at that, for they refuse to roll of their own accord, and the unloading at the store must proceed in the same way. Taken altogether, climbing up the tree, hacking through the leaves and the peduncle, getting down again, and carrying the bunches to the cart, the writer is of opinion that the coolie cannot, in a nine hours' day, visit more than 9 trees, and assuming a crop of two bunches per tree, his day's work is summed up by 18 bunches, which means that, at a daily wage of 75 cents, each bunch brought to the factory and split ready for treatment, will cost over 4 cents. Moreover, the work is so hard, so unpleasant that it is very doubtful if our ordinary class of coolie will stand it. It is pretty certain that coolies accustomed to the comparatively leisurely work of rubber or coconut estates will not look at it, and unless extra wages are paid it will be difficult to recruit the class of men required.

It is quite possible that in West Africa the natives, being expert climbers, give a greater output of work; yet Dudgeon tells us in "Agricultural and Forest Products of British West Africa" that it takes 8 minutes for a native to chop off a bunch.

The leaves are often, and should always be, cut long before the harvest, so as to favour the expansion of the bunch by reducing the compression exerted by the leaves. But what is more significant is "that the number of skilled palm-tree climbers is said to be decreasing in many districts and a very large proportion of the annual yield of fruit remains unharvested" (page 93). This does not say much for the attractions of *Elaeis* climbing as a profession.

The bunch which the writer is dealing with in this paper comes, as already stated, from a young tree and does not therefore, give quite a fair idea of the crop obtainable from the *Elaeis* palm, for as in the case of Coconut the full-bearing capacity of the tree is only reached when it has attained complete maturity. In his monograph, "The Oil Palm and its Varieties" J. H. J. Farquhar says, page 20:

"On the average, 5 bunches of fruit are produced per palm per annum; but it is common to find trees yielding many more. The average weight of a bunch is 31 lbs. made up of fruits 20 lb. and stalks, bracts, and calyx leaves which are worthless 11 lbs. The average number of fruit in a bunch is 1600 of which 600 or 38% are fully developed, 200 or 12% are imperfectly developed, and 800 or 50% are not developed."

The 20 lbs. of the fruit is made up as under (page 23)

the palm-oil extracted by native methods weighs	1.5 lbs.	
the kernels	4.0 lbs.	20 lbs.
the refuse, fibre and shells	14.5 lbs.	

5% of the weight of a whole bunch of palm-fruit may be considered oil, and at 5 bunches per tree this would mean 7½ lbs. of palm-oil yearly per tree.

One imperial gallon of cold palm-oil weighs 8½ lbs., accurately. The writer's own findings are:

One bunch ("maiden crop") weighs		18 lbs.
The bunch contained 206 fresh fruit perfectly developed weighing		7 lbs.
25 fruits, whole, after the calyx leaves and the peduncles had been cut off weighed	13.50 ozs.	
25 pericarps	5.75 ozs.	13.50 ozs.
25 fruits divested of their pericarps ..	7.75 ozs.	
25 pericarps gave of pericarp-oil (Palm-oil)	1.625 ozs.	

We need not attach any importance to the differences of weights of the bunches, as shown between the above two sets of figures: the bunch cut down in this case, being a "maiden" crop would be expected to weigh less than one cut from a mature tree: but when we come to compare the weights of the fruits and the

results in oil, the differences are wide. For instance, at the rate of 206 fruits to 7 lbs., it would require only 588 fruits to make up the 20 lbs. weight of 800 West African fruit (600 perfect and 200 imperfect). And the divergence in the outputs of oil is remarkable, but Farquhar's figure of 1.50 lbs. of oil to one bunch of fruit, applies to native methods.

As stated above, from the pericarps of 25 fruits the writer obtained 1.625 ozs. of oil. This was done in the following way. After freeing the fruit of their calyces and peduncles, the pericarps were sliced off with a sharp knife, cut up small, and passed through a special mincer which ground them to a fine paste. Boiling water was then poured, in small quantities, into the mincer, and the watery paste was allowed to escape by a tap at the bottom of the mincer into a pan which was put on the fire and boiled for 1½ hours, the mash being stirred the while, until the oil began to show itself on the edges, when it was dribbled from time to time into a cup. Boiling was continued, small quantities of water being added at times, until no more oil was seen to separate from the sediment which was put by until next morning when only a few drops of congealed oil had exuded. Perhaps a little more oil might have been obtained by pressing the sediment, but this was not done.

At first the oil is of a dark-brown orange colour, very clear, but the next day a very small quantity of sediment had formed at the bottom. In the early mornings it is congealed in the bottle and it takes the colour of anchovy sauce. The odour when fresh is pleasant, but eggs fried in it, came to the table with a deep orange film, suggestive of varnish or floor polish—and the flavour, to a palate accustomed to fresh coconut oil or gingelly-oil, was not quite pleasant. Yet, according to the *"Bulletin des Matières Grasses" No. 4, 1919, page 135*, palm-oil is one of the most advantageous materials for the manufacturing of margarine, when freed of its fatty acids.

The yield of 1.625 ozs. of pericarp-oil (palm-oil) from 25 fruits, means that, from 600 perfect fruits in an average bunch (we leave aside the 200 imperfect fruits), the resultant oil would be 2.43 lbs. per bunch, whereas the West African native, as shown above, obtains only 1.50 lbs. per bunch.

If we work out the above averages of outputs for an estate under systematic cultivation of *Elaeis guineensis* of say, one thousand acres, we should arrive at the following figures respectively:—

1,000 acres planted 27 × 27 feet = 50,000 trees.

50,000 trees giving 5 bunches each annually would give 250,000 bunches.

The *"Bulletin Economique et Financier du Journal d'Agriculture Tropicale"* of November, 1919 gives the following quotations.

Palm-oil Liverpool 10th November Congo £75 Lagos £83 per ton.

Palm Kernels London 10 November £38 to £38.10 per ton.

Therefore 250,000 bunches at 1.50 lbs. of oil = 375,000 lbs. Palm-oil at £80 per ton = £13,392.

250,000 bunches at 2.43 lbs. of oil = 607,500 lbs. Palm-oil at £80 per ton = £21,250.

Messrs. B. J. Eaton and F. G. Spring (Agricultural Bulletin F. M. S., Sept. and October, 1918) assuming a yield of 4,500 lbs. of fruit per acre, estimate the yield of palm-oil at 800 lbs. per acre; this would result in a yearly crop on 1,000 acres of 800,000 lbs. which, at £80 per ton, would give a gross return of £28,571. The discrepancies between the above figures show, if nothing else, the great need for further close investigations of the subject.

Palm Kernel Oil.

It may be useful to remind the reader that the above figures relate to *palm oil*, i.e. the oil extracted from the outside oily coat of the fruit. When this coat, or pericarp, has been taken off, there remains the nut, the Kernel of which has also a large oil content; this oil goes under the name of "palm-kernel oil."

The fruit of *Elaeis* is very much like the Coconut in structure, and the name "Klapa Kechil" given it by Javanese and Malays, is, botany apart, quite apt; for we have in both:

1st. The pericarp which instead of being of corky material, as in the Coconut, consists of a fleshy coat about $\frac{1}{8}$ inch in thickness in which are embedded, as strands of steel in reinforced concrete, straight and almost parallel fibres which converge towards the apex of the fruit. This coat, or pericarp contains of oil (extracted by solvents) 32.86% of the weight of the pericarp (C. W. R. Ralston).

2nd. A shell of the same stone-like hardness as that found in the Coconut—but harder in the *Elaeis* fruit; thickness, $\frac{1}{8}$ to $\frac{1}{4}$ inch.

3rd. A kernel of white "meat," filled with "water" in the Coconut, but full, *i.e.* without cavity, in the *Elaeis*. This "meat" has a bluish tint and is much harder than that of the Coconut.

It contains of oil (extracted by solvents) 43.96% of the weight of the kernel (C. W. R. Ralston).

The writer has found the weight of 25 kernels, divested of their shell, to be 2.12 ozs.

The writer has no personal acquaintance with this oil, nor, except from drawings, of the machinery in use for its extraction, but, as in the generality of cases, the extraction does not take place on the Estate itself the kernels being exported to Europe, it will be sufficient to take their market value, which in London is £38 per ton.

On the above basis of 25 nuts weighing 2.12 ozs. we should have from a 1,000 acre estate (250,000 bunches of 600 fruit) 357 tons of kernels at £38 per ton or £13,566.

Messrs. Eaton and Spring estimate a yield of ¼ ton of palm kernels per acre which is equivalent for 1,000 acres to 250 tons *i.e.* at £38 per ton, £9,400.

On this reckoning, taking only the figures relating to these countries, we have here two figures of the estimated gross revenue of a 1,000 acre Estate of *Elaeis* as under:—

	The writer's		*Messrs. Eaton and Spring*
Palm-oil	£21,250	.. ..	£28,571
Kernels	£13,566	.. ..	£ 9,400
Total Gross Revenue of 1,000 acres:	£34,816	.. ..	£37,971

Conclusion and Suggestions.

We have in these Countries two products of the soil which have great attractions for capitalists, namely Rubber and Coconuts, both safe industries, both paying handsomely, both easy of performance without strain of labour.

In considering Coconut, in particular, planters are accustomed to think in terms of copra only, and at the present time, with the staple at $30 per picul and 10 piculs of it, more or less, per acre, produced at small cost, and with a minimum of labour, there is really not much wrong with the coconut industry, from the money making point of view. Yet planters might make more of it and benefit their land, by the return of the "poonac," if they turned their copra into oil, as they do in the Philippines, but as it is, the industry flourishes exceedingly.

Now there are not a few people who think that there is room also in these countries for the cultivation of *Elaeis guineensis.* Perhaps that is so, but that will only be in places where the population is dense, and the recruiting of labour, men and women, assured at all times; for labour will be an all important factor, more important perhaps than machinery. So far we have only mentioned the difficulties which beset the coolies at the work of the gathering of the fruit, but it is not only the hardness of the work one has to look to, when dealing with *Elaeis,* it is also the great number of hands required to do it.

Whereas, for instance, on a coconut Estate, four coolies doing nothing else, will suffice to bring down the crop of 200 acres in one month, the same number of men will barely suffice to bring down a crop of 30 acres of *Elaeis* in the same time.

The same conditions apply to the labour at the factory. Whereas the manipulation of copra is of the simplest, requiring practically no machinery, the fruit of *Elaeis* is about as intractable a staple as can be conceived, requiring most elaborate machinery for the mere depericarping of the fruit, before extraction of the oil.

To satisfy himself on this point and find out where the difficulty lies, the writer effected the depericarping of 25 fresh fruit. With a very sharp knife, he worked continuously for 43½ minutes, slicing off the oily coating and the result was 5 ozs. of pericarp. It will be noticed that on a former occasion, when mak-

ing oil, the writer obtained 5¾ ounces of pericarp; this time, however, working against time, he probably did not scrape the nuts as carefully, and hence the loss of weight.

If we follow up this result, we find that a day of 9 hours should give an output of 62 ozs. or say, allowing for time wasted by the coolie 2½ lbs. of pericarp, yielding about 12 ozs. of palm-oil, worth about 6 pence. A daily task of 2½ lbs. of pericarp could not therefore be paid more than 4 pence, leaving 2 pence for cost of extraction of the oil freight and profit; plainly an impossibility, except where the very cheapest female and child labour can be drawn upon.

In this connection, a well known authority, Auguste Chevalier, (Bulletin des Matières Grasses de l' Institut Colonial de Marseille, No. 4, 1919) makes the following statement:

"A native of West Africa, working 300 days, produces yearly only 390 kilos of almonds, while another, treating the pericarps, obtains yearly 657 kilos of oil: the daily production of almonds not exceeding 1.300 kilos and that of oil 2.190 kilos."

2.190 kilos per day for two persons or say 1.100 kilos for one person, is more than treble what the writer himself obtained of oil; this is probably due to previous softening of the pericarps by fermenting in heaps, a native practice.

Taking as a daily task 1.100 kilos or 2 lbs. 7 ozs. of palm-oil per coolie per day, of a value (at £80 per ton) of 20 pence, it would perhaps be possible to pay a daily wage of 1/- sterling, leaving 8 pence for cost of extraction, oil containers, freight and profit. But the number of hands employed would be such as to render the operation impossible for an estate with a large production of fruit.

However, these figures may stand for the time being. Meanwhile the question naturally presents itself: what about machinery?

The writer is unacquainted with the various depericarping, depulping, grinding, and nut-cracking machines, which have for some time made their appearance on the market. Some of them, we are told, are made more to sell, than for anything else: others, having been working for some years, have proved their efficiency. But the writer has not seen any of them and his opinion would, at best, be only that of a layman: he must therefore borrow light from other, better informed sources.

Two such sources of information are now before him:

The Agricultural Bulletin F. M. S. for September and October, 1918, and the "Etude sur l'Exploitation industrielle du Palmier à huile," by Mr. Houard Director of Agriculture, Dahomey. The report is dated 1919.

On page 509 of the "Bulletin" reference is made to a German process installed in the Cameroons before the War. A summary description (to which the reader is referred for want of space) is given of the machinery and its mode of action.

Now if we dissect the process into its several changes from start to finish we shall find that the crop has to go through the following manipulations:

1° Cutting the bunches open to get at the fruit.
2° Removing the fruit from the divided bunch.
3° Transporting the fruit to the boiler.
4° Boiling the fruit for 1 hour.
5° Transfer of heated material, (by mechanical means presumably) to a number of mortars worked mechanically.
6° The stamping of fruit in the mortars.
7° The stamped-mass is steam-heated.
8° The nuts (for the sorting of which from the pericarp pulp some device must exist), are separated from the pericarps.
9° The transfer of the mass of pericarps to the hydraulic presses.
10° The extraction and reception of the oil from the presses.
11° The conveying of the oil to the sand filters.
12° The pumping into puncheons.
13° The disposal of the fibrous residue from the presses.
14° The separated nuts are transported to a barbecue or a drying-shed to dry.
15° The dried nuts are conveyed to the nut-cracking machines.
16° The nuts are cracked in a centrifugal cracker.
17° Kernels and broken shells fall in a tank below, filled with brine, in which the shells sink, and the floating kernels are collected.
18° The kernels, taken up from the brine, are put to dry.
19° The nuts are put in bags.

The total pre-war cost of such machinery is given as £3,500. The quantities treated 10 tons of fruit per day of 10 hours. The yield 16% of palm-oil 10% of kernels.

Accepting these data as exact, it would require to keep the mill at work for 300 working days of 9 hours to treat 2,700 tons of fruit. We base our calculations on a 9 hours day instead of 10 hours, as more in conformity with estates in Malaya.

If we reckon on a production of 5 bunches per tree per year, each bunch with 20 lbs. of fruit, and adopt the very generally accepted figure of 1½ lb. of palm-oil per bunch with 4 lbs. of kernels divested of shell, we shall come to a final result of:—

1 tree = 5 bunches = 100 lbs. of fruit = 7½ lbs. of palm-oil + 20 lbs. of kernels, and for one acre of 50 trees an annual return of 250 bunches = 5,000 lbs. of fruit = 375 lbs. of palm-oil + 1,000 lbs. of kernels. To produce 2,700 tons of fruit it will therefore require 1,200 acres of palms in bearing.

The whole production of 1,200 acres will be: 2,700 tons of fruit = (453,750 lbs.) 202 tons of oil + 536 tons of kernels.

202 tons of oil at £80 = £16,160
536 tons of kernels at £38 = £20,368 total £36,528.

It is perhaps a little bold, with such fragmentary information as we possess, to attempt to build an estimate of the total cost of an installation of this kind and of the expenditure incurred in running it. For that, it is necessary to visualise it as a whole, with its accessory and component parts and surroundings: but Mr. Houard's report (pages 198-199)) will supply us with several use-

ful figures, which, however, have had to be altered to Straits Currency and to estate conditions in Malaya, where salaries and wages are on a higher scale.

To begin with, the machinery, which is put at £3,500, pre-war cost, would now cost more than double and we can, without risk of surcharging put it down at £7,000 *i.e.* at $8.54 .. .. $59,780

Building of factory and engine house	12,000
Water Supply—pumps and reservoir (Water must be in abundance and constantly available)	1,500
Wagonets and rails for transport of fruit in the mill—also of fibrous and shell refuse	2,500
Drying sheds or barbecues	1,200
Store house	2,000
Tanks for brine with elevators	1,000
Spare pieces of machinery	2,000
Sand-filters and tanks to clarify the oil	2,000
Repair shop and tools	2,000
Offices	2,000
Manager's house	5,000
Chief Engineer's house	5,000
Clerks' and fitters' house	2,500
Coolie house	1,200
Total Cost of Installation	$101,680

Repairs and depreciation (20%) will amount to $20,336. We have now to work out the cost of running the mill on the assumption that 2,700 tons of fruit are treated per year.

Fortunately Mr. Houard's Report supplies us, under the heading "*Daily expenditure of a mill treating on an average 10 tons of fruits per day*," with a full schedule of the labour and staff employed, which is given below unaltered, except for the wages which are brought to Malayan standards.

	LABOUR:		*Yearly*
1	Receiving clerk paid daily	$2.00	$ 730
6	Coolies	.60	1,314
2	Men attending steriliser	.60	438
3	Men cooking the oil	.60	657
8	Men tending the presser	.70	2,044
2	Men tending the filters	.60	438
2	Men filling the casks	.60	438
4	Men tending the depulping machine	.60	876
4	Men tending the drying and the nut-cracking machines	.60	876
2	Engineers	3.00	2,190
2	Stokers	2.00	1,460
1	Fitter	4.00	1,460
1	Mason	2.00	730
1	Carpenter	3.00	1,095
	Carried Forward ..		$14,746

	Brought Forward ..	$14,746
2 Coopers	3.00	2,190
1 Black smith	3.00	1,095
1 Frappeur? (man who sounds the casks?) ..	.60	219
2 Bookkeeper		2,400
1 European manager		5,400
1 Chief Engineer		5,400
Fuel .. .. 50 francs per day		
Lubricant .. 3.		
Sundry .. 6.50		
——— = *f* 59.50 = $20 ..		7,300
Yearly Salaries Wages, etc. Total ..		$38,750

The mill requires a number of puncheons as oil containers, and of bags for the kernels.

Liverpool puncheons are 1 meter high and 1.30 meters at their broadest part; their weight 281 pounds; their content 205 Imperial gallons of oil, weighing about 1,590 lbs.

The puncheons are sent out from Europe, packed in pieces ready cut, with bands, bungs, and bottoms, and put up at the mill. Their cost at the mill was in pre-war days £1.19 made up as follows:

Manufacturer's sale price in Europe ..	£1.6.0
Freight	8.0
Landing at the Coast and transport ..	2.0
Cooperage (putting them together) ..	3.0
	£1.19.0

The present price would be, say double = £3.18.

As the mill has a nett production of 202 tons of oil to deal with, it will require 285 puncheons costing at £3.18 each, £1,111 converted at £8.54 = $9,488.

Kernels. Where loading facilities exist, the kernels are shipped in bulk—but where boats have to be used to the steamer, bags have to be used, which contain 1 hundredweight of kernels and would cost at present say $0.75 apiece. The output of the mill being 536 tons of kernels it would require:

10,720 bags costing	$8,040
Transport to the Coast and loading:	
285 puncheons oil at $4.00	$6,500
10,720 bags kernels at $0.50	
Insurance, freight, storage, Commission. Shortage *i.e.*	
50% on $83,213	$41,600

So far the yearly expenditure of the mill would be as under:

Depreciation repairs, etc.	$20,336
Wages and salaries	38,750
Puncheons and bags	17,528
Transport to Coast and loading ..	6,500
Insurance, freight, etc.	41,600
	$124,714

The produce sold in Europe, as shown above, would realise £36,528 or $311,950.

The 1,200 acre estate has therefore a credit balance of $187,236 to defray its expenses of cultivation, of harvesting, of transport to the mill, etc. *i.e.* $156 per acre.

The margin available for dividend will be a small one and might even be to the debit side of Profit and Loss Account.

The aim of this paper is not, as might be inferred, to make a case against the cultivation of *Elaeis*. The question is too large a one to be approached with prejudice, for there is little doubt that, placed under favourable conditions, the oil yield of *Elaeis* is so great that it puts the palm at the head of all oil-yielding plants of the world.

The question, in fact, is full of interest and it deserves to be probed in a much fuller way than is done in this paper.

The pioneers of Rubber planting were, for a long time, pulled this way and that, in their first steps in the, then, new industry. Some, on expert advice planted *Ficus elastica* others *Ceara*, and a good deal of money was sunk in putting these in the ground—and more money went in cutting them down afterwards. On the whole, however, the birth of the rubber was not a painful one, and the child has grown into a hefty boy. But blunders will cost more in the case of *Elaeis*: bad selection of land, wrong selection of seed, will kill it.

The writer has just received, and has now before him, photos taken in West Africa and, amongst them, are two bunches of *Elaeis* collected in the District of Lusango (Congo). One, standing on a table, must be, judging from the height of the man holding it, at least two feet high and nearly as broad,—a perfect mass of fruit, but its weight is not given. The second one is probably as big, but there being no standard to judge by, it cannot be estimated; its weight, however, is given as 62.750 kilos or 136 pounds!

Now, if the usual computations hold good in this case, that is, that the fruit weighs ⅔ of the weight of the bunch, we have 88 lbs. of fruit, of which the oil-yield as obtained by machinery *i.e.* 16%, would amount to 14 lbs., and, as a conservative estimate would put the yearly crop of bunches at 5, we should have from one tree, 70 lbs. of oil and from one acre of 50 trees—3,500 lbs. of oil worth £125 in London. If besides, we reckon the weight of kernels at 20% of the weight of the fruit, we should get a crop of 88 lbs. for 5 bunches = 4,400 lbs. of kernels per acre worth £74. That is to say, the gross return of one acre would amount to £199.

There seems no reason why, under careful systematic cultivation, and under suitable conditions of soil and rainfall, which these countries afford, such bunches should not be obtained; then, of course, the whole aspect of *Elaeis* planting would change provided the labour is at hand.

Trees are not uncommonly seen in Malaya with 8 or 10 bunches; the writer has seen one in Sumatra with 12 bunches

which would all be ready for cutting within twelve months. But the question is governed also by the yield of oil and of kernels. As shown by the analyses made by the Imperial Institute, some varieties like the "Au Suk Ku" yield as much as 83% of pericarp and 48% of oil, while others, like the "Udin" show only 25% of pericarp and 16.5% of oil.

The following points also invite consideration, firstly the fact that *Elaeis* grows in pure natural stands on the West Coast of Africa and secondly, that there it is only fourteen days from the European markets.

The whole problem of the future of *Elaeis* is, in fact, bound up with:—

1°. Selection of suitable varieties yielding thick fleshy pericarps with heavy oil content and heavy kernels with preference for short-stemmed trees which greatly reduce the cost of cropping, (as is the case with the dwarf coconut) and for those which mature their fruit at well defined periods.

2°. Selection of land, preferably flat land, with water transport both within the estate and to the coast; irrigation where dry seasons are prolonged; ~~plowing~~ ploughing between the rows of trees; heavy pruning of the lower leaves especially those that encircle the bunches; search for beetles; using the "poonac" for manure.

3°. Easing of the work of cropping, which certainly admits of much improvement. The adoption of light folding-ladders allowing the coolie to use both his hands; of powerful hand shears or tree-pruners to cut through the peduncle of the fruit.

4°. A judicious use of native methods of "depericarping," blended with mechanical devices of well authenticated efficiency.

5°. A settled population from which to draw labour.

E. Mathieu.

(*To be continued.*)

References.

"Le Palmier a huile" Paul Hubert.

"Bulletin des Matières Grasses de l'Institut Colonial de Marseille," 1919. Nos. 4 and 5.

"Agricultural Bulletin F. M.. S." September-October, 1918.

Dudgeon. "Agricultural and Forest Products of W. Africa."

J. H. J. Farquhar "The Oil Palm and its Varieties."

"Bulletin Commercial et Financier du Journal d'Agriculture Tropicale," November, 1919.

"Bulletin de l'Association des Planteurs de Caoutchouc," November, 1919.

A Host Index of Fungi of the Malay Peninsula ,I.

Although we are only at a beginning of our study of the cryptogamic flora of Malaya, it has been found that in collecting together the information already published in separate papers the material has been provided for a nucleus of a Host Index for this country. It has been considered advisable that this information should be published forthwith in index form and added to as further records are established, rather than delay publication for some years in order to obtain a more complete work.

In considering the form this work should take it has been deemed expedient to include all fungi recorded on a plant rather than only those that have hitherto been definitely determined as parasites. The advantage of such a list being in the first place that it is very difficult to establish definitely which are parasites and which are saprophytes, and secondly fungi determined as saprophytes now may in a little while be found to be parasites. In this matter the following list differs somewhat from the Host Indexes that have been issued for other countries.

Many well known diseases often regarded as quite common will not be found included as it often proves on investigation that such popular beliefs have not been actually recorded by the scientist.

The arrangement of the list is alphabetically under the host plants. A systematic arrangements of hosts was considered to limit the use of such a list as this to those few scientists who are familiar with systematic botany, and as it is hoped this list will prove useful to a larger circle the alphabetical arrangement has been adopted. For a similar reason the descriptions of the fungi have been given in popular language rather than scientific.

The material from which this list has been compiled is the works of H. N. Ridley, W. J. Gallagher, K. Bancroft, A. Sharples, W. N. C. Belgrave, R. M. Richards, and C. F. Baker published during the past few years in local bulletins and periodicals.

AFZELIA RETUSA, Kurz. (*Leguminosae*) Merabau.

Bancroft records the leaves of 'Merabau' collected in Perak, attacked by a fungus he considered to be *Trabutia Stephaniae* (*Sphaeriaceae*).

AFZELIA, sp. (*Leguminosae*) Merabau.

Fomes lignosus, (*Polyporaceae*) the well known disease of Para rubber, was recorded by Gallagher as spreading from 'Merabau.'

AGATHIS ALBA, Foxw. (*Coniferae.*)

Aecidium balansae, (*Uredinaceae*) was found on leaves of this species collected by Burkill on Penang Hill. It causes warty gall like protuberances on the upper surface of the leaves.

AGAVE RIGIDA, Mill. (*Amaryllideae.*)

Dead preduncles collected by C. F. Baker, at Singapore, were found to have a species of *Phoma*, which was described by Saccardo as a new species, *P. agaves*, (*Sphaerioidaceae*). It is a minute fungus causing little raised black spots where the frutification breaks through the epidermis of the host.

AGAVE, sp. (*Amaryllideae*).

A species of *Coryneum* (*Melanconiaceae*) is recorded by Burkill in Singapore and Johore as attacking the leaves and rendering them useless for the extraction of fibre. It first appears as white blotches which on spreading change to a deep brown colour and become sunken. When the leaf is dead it has a silvery look and the fungus appears externally breaking through the epidermis as small black pustules, which are often in more or less concentric rings.

ANDROPOGON NARDUS, Linn. v. CITRONELLA. (*Gramineae*).

A Rust, *Puccinia clavispora* (*Uredinaceae*) causing long reddish brown streaks on the leaves is recorded by C. F. Baker from specimens collected in the Singapore Gardens.

ARACHIS HYPOGAEA, Linn. (*Leguminosae*). Ground nut, Pea nut, or Monkey nut.

Bancroft records from Selangor a leaf spotting parasitic fungus, *Cercospora personata*, (*Dematiaceae*). The fungus appears as small, brown, orbicular spots 2-4 mm. or more in diameter. The spore bearing hyphae are short, brown, and densely tufted.

ARECA CATECHU, Linn. (*Palmaceae*). The Betel Nut.

C. F. Baker found a fungus on the dead leaves at Singapore. *Saccardo* described it as a new species *Exosporium* (*Bakerella*) *eximium* (*Tuberculariaceae*). The fungus appears as minute black tufts chiefly along the main veins of the leaves.

ARTOCARPUS INTEGRIFOLIA, Linn. (*Urticaceae*). The Jack Fruit.

A case of 'Pink Disease,' *Corticium salmonicolor*, (*Thelephoraceae*) is recorded in Malay by F. T. Brooks. Ridley in 1889 also collected specimens of *Hexagona polygramma* (*Polyporaceae*) from a dead Jack-tree at Jurong. This latter fungus is a thin, brown, circular, bracket shaped specimen with large regular hexagonal pores on the under surface. So far as is known the genus Hexagona is saprophytic.

ATTALEA COHUNE, Mart. (*Palmaceae*). The Cohune Nut Palm.

Gloeosporium palmigenum (*Melanconiaceae*) was found by C. F. Baker at Singapore on dead leaves of this palm. The fungus appears as minute spots, brown but ringed with a black edge.

BAMBUSA, sp. (*Gramineae*).

Specimens of *Polystictus occidentalis* (*Polyporaceae*) are recorded by Ridley as occuring on the outside of a bamboo clump. On cutting open a culm the mycelium of the fungus was found to be lining the inside in a thick, firm, leathery mass.

BOEHMERIA NIVEA, Gaudich. (*Urticaceae*). Ramie fibre.

Mentioned by Ridley as attacked by 'Pink Disease.' *Corticium salmonicolor* (*Thelephoraceae*).

BROWNEA GRANDICEPS, Jacq. (*Leguminosae*).

C. F. Baker records from the Singapore Gardens a fungus described by Saccardo as a new species *Microthyrium browneanum* (*Microthyriaceae*). This fungus appears on the leaves as minute black dots.

BRUGUIERA ERIOPETALA, W. et A. (*Rhizophoraceae*).

Two fungi are recorded from the leaves of this host by C. F. Baker from Ponggal, Singapore. *Helminthosporium subsimile* (*Dematiaceae*) and *Podosporium consors* (*Stilbaceae*).

CALAMUS, spp. (*Palmaceae*). The Rotan.

Only three fungi, found by Baker in the Singapore Gardens are recorded for this important section of Palms. On dead petioles and leaf rachises *Melanconium melanoxanthum* (*Melanconiaceae*), appearing as small white dots ringed with black. On dead stems *Coniosporium vacuolatum* (*Dematiaceae*) appearing as small black spots and splashes. *Hadrotrichum atromaculans* (*Dematiaceae*) also on dead stems causing black incrustations, and mixed with *Melanconium melanoxanthum*.

CALLOPHYLLUM FLORIBUNDUM, Hook. f. (*Guttiferae*).

Leptothyrella calophylli (*Leptostromataceae*) a black sooty fungus is recorded as a parasite on the living leaves, by Baker at Singapore Gardens.

CASSIA FISTULA, Linn. (*Leguminosae*). Purging Cassia.

Meliola aethiops (*Perisporiaceae*) a black cobwebby fungus found on living leaves in Singapore Gardens, by Baker.

CASSIA TORA, Linn. (*Leguminosae*).

A rust, *Aecidium torae* (*Uredinaceae*) was found by Burkill on a specimen growing at Tanjong Pagar, Singapore. It appears as little bright clusters of cup shaped frutifications on the leaves.

CASSIA, spp. (*Leguminosae*).

Other species of this genus are reported as being found with Pink Disease, *Corticium salmonicolor* (*Thelephoraceae*) by Brooks;

Peronentypa heteracanthoides (*Sphaeriaceae*) appearing as minute black pustules on the wood, and *Hypoxylon microsporum* (*Sphaeriaceae*) which causes black charcoal-like eruptions on the bark. These latter two are recorded by Baker from Singapore.

CECROPIA PELTATA, Linn. (*Urticaceae*). The Sloth Tree.

Botryodiplodia cerebrina (*Sphaerioidaceae*) appearing as black eruptions on the bark was collected by Baker at Singapore.

CINNAMOMUM CAMPHORA, Nees. (*Laurineae*) Camphor.

One of the worst troubles affecting this plant is a "thread blight" which weaves a regular white cobweb over young specimens even up to 12 ft. high, and eventually smothers them. It was described by Bancroft in 1911 and was referred doubtfully to a species of *Corticium* or *Hypochnus*. No practical remedy has yet been suggested for removing it as it is difficult to treat young trees growing in the jungle.

Bancroft also reports *Hymenochaete noxia* (*Thelephoraceae*) as causing a root disease, and *Fomes lignosus;* and Brooks that Pink Disease has been found on this tree.

Quite recently specimens from Selangor that have presented the symptoms of 'die back' have been collected. A black *Sphaeriaceous* fructification was found on the bark, but the work on these specimens is not yet completed.

CINNAMONUM INERS, Bl. (*Laurineae*).

Baker reports that he found *Microxyphium tenellum* on dying leaves of this plant in the Singapore Gardens.

CITRUS ACIDA, Roxb. (*Rutaceae*). The Lime Tree.

Although one would expect several pests of this tree to have been collected, the only one recorded is that by Baker from Singapore, namely, *Cladosporium elegans*, var. *singaporense* (*Dematiaceae*) collected on dying leaves.

CITRUS MEDICA, Linn. (*Rutaceae*). The Citron.

Sphaerostilbe coccophila (*Hypocreaceae*) found by Bancroft is not really parasitic on the tree but on the scale insects which so frequently infest trees of this kind.

CITRUS, sp. (*Rutaceae*).

Brooks reports a case of Pink Disease on the "Lime," but the exact species is not indicated.

CLERODENDRON PENDULIFLORUM, Wall. (*Verbenaceae*).

Tetrachia singularis (*Tuberculariaceae*) is recorded by Baker as being found on living leaves at Singapore.

CLERODENDRON SERRATUM, Spreng. (*Verbenaceae*).

Baker collected *Podosporium penicillium* var. *clerodendri* (*Stilbaceae*) on the leaves of this species. This fungus appears as little white specks on the leaf surface.

CLITORIA CAJANIFOLIA, Benth. (*Leguminosae*).

This is another of the hosts of Pink Disease, recorded by Sharples.

COCOS NUCIFERA, Linn. (*Palmaceae*). The Coconut Palm.

The diseases and pests of this important palm are summarized by R. M. Richards in the Agricultural Bulletin Vol. V, p. 327. A complete list of the fungi found in Malaya so far are:—

Botryodiplodia, sp. (*Sphaerioidaceae*). A cause of die back of the leaves. Stated by Ridley to be a root disease cutting off the water supply, but Richards considers it to be a leaf parasite killing the leaf as it works downwards from the tip.

Bud rot. The most recent work on the fungi concerned in this disease is given in the Philippine Journal of Science Vol. XIV, No. 1, Jan. 1919.

Diplodia, sp. (*Sphaerioidaceae*). Reported by Bancroft on the roots but only secondary on dead parts.

Fomes pseudoferreus (*Polyporaceae*). Found by South on dead stumps and roots.

Fomes lucidus (*Polyporaceae*). Found by South on buried wood.

Fomes pseudoferreus (*Polyporaceae*). Found by South in buried trunks and previously described as *Poria hypolateritia*.

Helminthosporium sp. (*Dematiaceae*). Richards records on the leaves.

Hexagona variegata (*Polyporaceae*). Collected by Burkill from a dead trunk.

Hymenochaete noxia (*Thelephoraceae*). On buried trunks. Recorded by South.

Meliola palmarum (*Perisporiaceae*). A saprophytic sooty mould fungus covering the leaves, and probably due to the presence of scale insects. Its treatment is given by Bancroft in Agricultural Bulletin, F. M. S. Vol. I, p. 110.

Metasphaeria Cocoes (*Sphaeriaceae*). A saprophytic fungus recorded by R. M. Richards on dead leaves.

Pestalozzia palmarum (*Melanconiaceae*). Described by Bancroft as a cause of a spotting of the leaves. These spots finally coalesce and appear like a large grey blister.

Poria hypolateritia (*Polyporaceae*). Described by South as being found in buried trunks. This fungus has since been redetermined as *Fomes pseudoferreus*.

Thielaviopsis sp. (*Dematiaceae*). Recorded originally by Bancroft in the tissues of the stem. Later Richards considers that *T. ethacetica* is the cause of "rusty and black patches (on the stem) from which a brown liquid oozes."

COFFEA, spp. (*Rubiaceae*). Coffee.

Unfortunately the many diseases recorded for this plant in Malay are generally mentioned as occurring only on "Coffee." In only one or two cases has the species or variety of Coffea been stated. Consequently it has only been possible to group the following under the generic name.

Ascospora sp. A stem disease of not very great importance.

Capnodium sp. (*Capnodiaceae*). A "sooty-mould" fungus described by Belgrave as being found in association with scale insects on the berries. It is considered harmless except so far as it cuts off the light from the fruit.

Cephalosporium sp. (*Moniliaceae*). Recorded by Belgrave as being parasitic on the spots caused by the leaf fungus *Hemileia*. It appears as a fine glistening white web on the mature spots.

Colleototrichum sp. (*Melanconiaceae*) found by Belgrave on stems. It causes black discoloured areas in which may be seen small knob like protuberances.

Coniothyrium coffeae (*Sphaerioidaceae*). One of the fungi found by Belgrave as being responsible for the large, brown, 'scorched' areas on leaves. The fungus seems able to attack healthy leaves.

Corticium salmonicolor (*Thelephoraceae*). Pink Disease. Recorded by Brooks.

Diplodia sp. (*Sphaerioidaceae*). Found by Belgrave on the stem and occurring as large hairy pustules.

Fusarium sp. (*Tuberculariaceae*). Collected on dead berries. Belgrave states that this fungus appears unable to infect healthy fruits.

Hemileia vastatrix (*Uredinaceae*). A rust. The most widely spread "leaf spot" disease. It first appears as small circular, yellowish, translucent spots, and is rapidly followed by the production on the underside of the leaves of the orange coloured powdery spores.

Hyalopus sp. (*Moniliaceae*). With *Cephalosporium* appearing as glistening patches on *Hemileia* spots.

Hymenochaete noxia (*Thelephoraceae*). Recorded by Bancroft as causing brown root disease.

Irpex flavus (*Hydnaceae*). Considered to cause a root disease. A bright yellow fungus covered with "teeth."

Necator discretus (*Tuberculariaceae*). Mentioned by Ridley as causing a considerable amount of damage to the stem. It appears as "small white specks which seem to develope into leprous pink masses forming patches on the dying twigs."

Pestalozzia coffeae (*Melanconiaceae*). Belgrave records this fungus on the fruits, appearing as little black dots on raised patches.

Phyllosticta coffeicola (*Sphaerioidaceae*). Another of the fungi responsible for the "scorched" appearance of the leaves. Little black pustules are seen on the large brown areas.

Stilbum sp. (*Stilbaceae*). A saprophytic fungus found by Belgrave on dead fruit.

CYRTOPHYLLUM FRAGRANS, D. C., (*Loganiaceae*) Tembusu.

Baker records two fungi on the leaves of this tree, as being found in Singapore. *Septoria cyrtophylli* (*Sphaerioidaceae*) forming light grey spot areas with concentric zones, and covered with black pustules, and *Helminthosporium spirotrichum* (*Sphaerioidaceae*) which forms dense masses of jet black mould chiefly on the under surface of the leaves.

DAEMONOROPS, sp. (*Palmaceae*). Rotan.

Phyllosticta daemonoropsis (*Sphaerioidaceae*) is recorded by Baker from Singapore as being found on the leaves, and appears as brown scorched areas.

Rosellinia ambigens (*Sphaeriaceae*) was found on dead leaves, and occurs as lines of black dots.

DERRIS SINUATA, Thw. (*Leguminosae*).

Asterina trachycarpa (*Perisporiaceae*) a fungus occuring as groups of black dots on the surface of the leaves was collected by Baker in Singapore.

DIANTHUS CHINENSIS, Linn. (*Caryophyllaceae*). Pinks.

The dead calyces collected from specimens at Singapore by Baker were found to have on them *Phyllosticta dubia* (*Sphaerioidaceae*). All that appears of the fungus on the surface is minute black dots chiefly towards the ends of the calyx lobes.

DICTYOSPERMA ALBUM, W. and D. (*Palmaceae*).

Phyllosticta palmigena (*Sphaerioidaceae*) collected from dying leaves, by Baker at Singapore. It appears as white scorched areas surrounded by dark brown or black borders.

DIOSCOREA, sp. (*Dioscoreaceae*). The Yam.

Stilbum incarnatum (*Stilbaceae*). Collected on rotting roots by Baker at Singapore. In dried specimens the red colour of the young united spore stalks is long retained, and is characteristic of the groups of fructifications.

DURIO ZIBETHINUS, D .C. (*Malvaceae*). The Durian.

Brooks records an instance of Pink Disease, and Baker the occurrence of *Glocosporium zibethinus* (*Melanconiaceae*) on the

leaves. In the dried material the leaves have 'scorched' spots or areas, spotted with black dots and surrounded by dark brown borders.

EUGENIA CARYOPHYLLATA, Thunb. (*Myrtaceae*). The Clove.

Irpex flavus, a yellow "toothed" fungus (*Hydnaceae*) is reported by Bancroft as causing a root disease. Ridley states that a red-spotting leaf fungus, probably a member of the *Peronosporaceae*, was responsible for abandoning the clove cultivation about 1860.

EUGENIA GRANDIS, Wt. (*Myrtaceae*). Jambu Ayer Laut.

Valsaria cinnamomi (*Sphaeriaceae*) on dead bark, collected by Baker at Singapore. The fructifications of the fungus appear as dark brown or black eruptions through fissures of the bark.

T. F. CHIPP.

(*To be continued*).

Some Trials of Food Plants in the Economic Gardens II.

Lima Beans (Phaseolus lunatus).

The Lima Beans, Small Siéva Pole, originally received from the firm of A. H. Dreer, Philadelphia, U. S. A., and which were reported upon at length in the Garden's Bulletin of 4th July 1919, have been kept under cultivation continually in the Economic Gardens since July 1918. It was shown, by the records of seed gathered up to, and inclusive of the fourth generation, that the crops had been well maintained and that the beans had not degenerated in weight, size or quality.

But the results since obtained do not confirm this; they in fact have disappointed the writer's expectations. It is not, however, yet time to ascribe the falling off in the subsequent crops to actual degeneration in the seed, for, in recent weighings taken in October 1919, it was found that the weight of the beans was well maintained, and the percentage of germinations on a plot of 1056 plants, sown on 28th October, the last of the season, was as high as 96 per cent. At the time of writing (22nd November) this plot shows the most vigorous and healthy growth, a fact which would exclude any tendency to degeneration.

To explain the discrepancy between this last statement and the disappointing results of the crop as a whole, it is necessary to refer to the locality where the trials were made. The area planted in Lima beans was a little over two acres consisting (all but a small part of 4000 square feet, or one eleventh of an acre) of a low strip of land skirting a hill, and made of drift soil, either washed from

Ragi, Eleusine Coracana.

the hill side, or brought by the floods which frequently occur. It is therefore of an alluvial character, of good depth and of a fine loamy texture, the very best medium one would think for a trial of this nature; actually however, it was not at all suitable.

To begin with, it had been for years under a rank, semi-aquatic vegetation of wild grasses and of Pandanus (Screw-pine), with a few stunted Rubber trees. The large sago-palms growing near-by, mark the land for what it really is namely an undrained, almost undrainable swamp: its structure, a peaty bottom overlaid with the rich silt brought by floods. Such is the land with the exception of the small plot of $1\frac{1}{4}$ of an acre referred to above, a gentle slope at the foot hill, well above flood level. Here is no drift or alluvial soil but the ordinary coarse yellow sandy clay, characteristic of Singapore hill-sides. This small plot had been for some years under cultivation and sundry annual crops had been raised off it in 1917 by Professor Baker (see Gardens Bulletin July 4th 1918). Now, it is off this small plot of rather poor and thin material, that the crops of Lima beans were grown by the writer, the results of which were given in the Bulletin of 4th July 1919, and on it are still to be seen beds of Lima beans of healthy growth, with abundant crops on them. One bed, in particular, sown on 31st July 1918, shows at date of writing, quite a fair crop of young pods. What, then, is the explanation of the unsatisfactory return of the *ensemble* of the crop? How is it that the promising results previously obtained, as shown in Bulletin No. 4 of 1919, now fail?

In the writer's opinion, this failure is due to the host of diseases brought about by fungi and insect pests which are bound, in the natural course of things, sooner or later to attack and destroy plants grown under adverse conditions in an uncongenial soil. And here, for the sake of clearness, one may be permitted a slight digression. In some countries, Burmah for instance, we hear of the Lima bean being grown on alluvial deposits formed along the river banks, by the silt of periodical inundations, a condition resembling somewhat that under which the Economic Gardens are placed. But there is this difference between the case of periodical seasonal floods and the case of occasional floods which last only a few hours over undrained land. In the one case, the parasitic fauna and flora is killed by the prolonged sojourn of the waters on the land, moreover the steady withdrawal of the river water to a much lower level as the floods subside, allows of perfect drainage of the alluvial deposit left on the land. Thus a perfectly new soil is formed, perfect in nutritive elements for plant life, perfect in physical texture, and above all, a soil purged of fungoid and insect pests—a clean soil which, with a minimum of tillage, will bear such wonderful crops of tobacco and indigo as one sees, for instance, on the banks of the Mekong.

In the other case, new soil is brought on the land, carrying with it seeds of parasitic vegetation and spores of new fungi which find a congenial home in the rank vegetation, a vegetation which thrives all the more for a short immersion, and as the land drains

itself badly and slowly, the cleansing action of the withdrawal of the flood water is lost—result: a sloppy, acid land, infested with pests of every description—a foul land. That is precisely what this land is, which is now dealt with. A foul land, no matter how great its wealth of nutrient material, cannot be fit for intensive cultivation except after a period of repeated tillage and, even then, if the surrounding land is allowed to remain foul, the harvests will be precarious. It is said by people who know the country well, that it is very difficult to rear good dependable garden crops in the rich lowlands of the East Coast of Sumatra, because of the peristent attacks of pests; and this is explained by the fact that so much of the land, after the tobacco crops have been harvested, is allowed to revert to rank vegetation over which parasitic life runs riot.

This digression will serve to explain the failure of the Lima bean crop in the Economic Gardens to come up to expectations. The failure of a crop, however, does not necessarily imply the degeneration of the seed; but certain figures of weighings taken by the writer at different periods bear on this point and they are here given.

A. One handful of beans of the third generation put on one side of the scale numbered 55 beans: one handful of beans of the fourth generation put on the other side tilted the scale with 56 beans.

B. 100 seeds taken from a parcel of Lima bean seed received from the firm of A. H. Dreer, Philadelphia, on 19th June, 1919, were put on one side of the scale and it took 120 of our local selected seed, after one month's drying to tilt the scale. (The local seed were the offspring of seeds received from the same firm the year before).

C. One pound of beans picked on 23rd May 1919, and kept to dry for 8 days contained 916 beans, whereas,

D. one pound of beans picked on 20th October, (*i.e.* the following generation) and kept to dry for 12 days contained 1103 beans.

E. One pound of beans selected for sowing in October, contained, after one month drying, 910 beans.

As will be perceived, while some of these figures point to a decided falling-off of the beans in weight as shown in B and by comparing C and D, others, A, and a comparison between C and E do not point to the same conclusion.

In B, however, we have clear evidence, (several weighings were made with much the same results) that the local bean, after nearly twelve months cultivation in the Economic Gardens, has lost 20 per cent of its weight. Is that fact to be taken as a proof that the Lima Bean cannot establish itself in this country without degeneration? It must be remembered that the seeds sent out by the great seedsmen of Europe and America have been evolved by severe selection through successive generations under trained observers to produce a type of bean in this case suitable to a set of local conditions which may, or may not, be reproducible elsewhere,

Hill Paddy, Sown on 20th July, gathered on 10th December.

or only partially reproducible. The chances are that, in their ensemble, they are not reproducible, for the factors which enter into play are many, *e.g.* heat, moisture, constitution of the soil, pollinating insect life, and processes of cultivation are among the factors that work for divergences, and that affect the behaviour of the plant under altered conditions. There is, then, nothing surprising in the fact that the Lima bean, in its transfer from a temperate and relatively dry climate to a tropical and moist one, should suffer a decline from the parent seed. The question is whether, under successive generations of cultivation, the decline is continuous. If this were so, it would, of course, imply progressive degeneracy in the seed and the inadaptability of the Lima bean to our local conditions since reproduction of a seed true to type is the test of adaptability to surrounding conditions—of acclimatisation.

Now tests C and D seem to support the contention that the Lima bean does, in effect, lose in weight from one generation to the next. Here we have 2 lots of beans gathered off the same plot one belonging to one generation containing 916 beans to the pound —the second lot belonging to the following generation containing 1103 beans to the pound that is to say that the latter is 20% lighter than the first.

This may appear to clinch the matter and finally to settle the point of degeneration in the seed. But does it? The writer would be quite prepared to admit it, were it not for the adverse conditions under which the later crops have been reared—conditions which the above digression was meant to make clear.

As can be seen by visitors to the Economic Gardens, the cultivation of the various plots has been as thorough as it is possible to make it in this country and some of the standing crops, ragi, hill paddy, cholam (Sorghum vulgare), new to the land and, so far, immune or at least partly so, to the pests that infect the land, show quite adequate returns, birds notwithstanding. But in the sections where bean cultivation has been going on now for several months, the fight is all but hopeless. *Nematodes*, the *Agromyza* fly, *Bruchus rufimans*, also a black bug, round-bodied with shiny carapace, the name of which is not known to the writer, leaf fungi and root fungi have made a set-attack on these plots. Disinfection of seeds, sprayings with Bordeaux mixture and with insecticides, sulphur dustings, petroleum emulsion, neem oil emulsion, have been used without interruption, all with only very partial effect.

Referring again to the tests given above, the figures under A appear to negative the degeneration of the Lima bean from the third generation to the fourth generation: these weights were taken before the various above pests had taken such a hold of the land, but, unfortunately, it was found impossible to carry on these comparative tests with the later crops as the percentage of damaged beans was too great to make the tests of any use.

Test E was made from seeds obtained from the smaller plot previously referred to; but the test is inconclusive from the fact

that the seeds were selected for sowing, and were therefore plumper and, no doubt, heavier than average seeds would be.

As a conclusion to this paper, it may be stated:—

1st. That the Lima bean, Small Siéva, locally grown, shows a falling off in weight of 20 per cent. from the original parent seed received from Philadelphia.

2nd. That a falling-off in weight has taken place in the later crops, but that the adverse conditions under which the latter were grown, and probable loss of vitality from disease, make it unsafe to conclude that this falling-off would be continuous under normal conditions.

3rd. It may be pointed out that the Lima Bean is cultivated on a very extensive scale in the different countries surrounding us, and figures largely in their exports. Burmah has its Rangoon bean: Java its Java bean; Cochinchina its Haricot de Baria, the self—same "Small Siéva" which is under trial at the Economic Gardens, and all belonging to the species *lunatus*. In the face of this fact it will need very strong evidence to prove that it cannot be cultivated and acclimatised in this country, under normal conditions.

Roselle (Hibiscus Sabdariffa.)

The Roselle bush known also in the West Indies as "Jamaican" or "Red Sorrel," is a member of the Natural Order Malvaceae and is allied to the Bandikai or Lady's Fingers, and the Cotton plant. It was first planted in the Economic Gardens by Professor Baker who introduced it from the Philippines, and both the red, and the white "*Victor*" variety have been kept under cultivation there. Both plants develop into handsome bushes 5 to 6 feet in height with an abundance of almost horizontal branches spreading to a circumference of 4 to 5 feet in the lower part of the tree, which assumes a well defined pyramidal shape.

The so-called "*White*" Roselle is green in its wood, in its branches, and its leaves, but the calyces of the fruit are whitish green or straw coloured. The Red Roselle has a reddish bark and is quite distinguishable from the white type by the brilliant deep red colour of its calyces, which gives the jelly and jam made of it a very attractive red colour whereas the jelly made of the White Roselle takes the colour of amber.

This year, a consignment was received of seeds of the variety "*altissima*," new to the garden, and also of two distinct red and white types. Five beds were sown at the end of April, 1919, and on the 10th November, the first crop of fruit was plucked.

It is quite distinct in growth and habit from the Roselle of the "*Victor*" variety, the only one which had hitherto been cultivated in the Gardens. It is a much taller plant, attaining 10 to 12 feet in height, and the branches, instead of spreading horizontally as those of the "*Victor*" variety, grow at an acute angle to the stem, giving it a more slender appearance.

All its parts, even the calyces, are covered with short rough hair: the fruit, which is smaller than that of the "*Victor*" variety, is also rounder and the sepals, in the white type, are peculiarly streaked with faint lines of red spots. The fruit of the two varieties are here shown, side by side, in their natural size and shape.

Hibiscus Sabdariffa var: *Victor*
natural size
Colour—greenish white

Hibiscus Sabdariffa var: *Altissima*
natural size
White—spotted red

The "*altissima*" variety, although fairly prolific in fruiting, is less so than the "*Victor*" variety, and the smallness of its fruit, coupled with the more marked hairiness of the sepals make it a less desirable acquisition, for the purpose of making preserves, jams, jellies, or syrups.

Roselle has a long tap-root and it therefore requires a soil previously well dug to a depth of 10 inches. The writer, having planted it in varied kinds of soils, is of opinion that it thrives best in a fairly heavy clay soil, but being of rapid growth, it wants a soil well supplied with plant food. It is very grateful for a light application of well rotted cowdung. The land should be well drained, as the plant is somewhat subject, more particularly in low wet land, to the attacks of root-nematodes which dwarf it and render it unfruitful.

Roselle Jam or Jelly is well appreciated by all who know it, and, it is a great help to the housewife, in these times of costly and indifferent jams which figure in the market.

In making jam the sepals and calyces of the fruit alone are used, the seed-bag inside being cut-out and rejected. But the whole fruit can be used when making jelly, as in this case, the seed-bag is strained off.

The process for making jam is briefly as follows: Strip the calyces off and throw them in cold water to rinse them for 2 to 3 hours,—not longer—as, particularly in the case of red roselle, some of the pigment passes into the water and is so much loss in brilliancy of colour of the jam.

The calyces are then put in an earthenware pot or, if metal is used, it must be either a copper or enamelled pan. Boil in water sufficient to cover the fruit, for thirty minutes, more or less,

until the pulp is quite soft; add clean white sugar at the rate of ¾ pound to one pound of calyces; bring again to the boil for about 10 minutes, skimming meanwhile the scum that forms on top. The jam is then ready to put in bottles which must be previously heated; when cool, cover the mouth of the bottle with a round of paper previously moistened with white of egg, and applied to and overlapping the lips of the bottle.

This bottling is efficient if the jam is intended for home consumption in a relatively short time, but if it is intended to be kept, or if it is made for sale, then it is essential that the jam should be thoroughly sterilised. A very simple process of sterilisation was given in a leaflet of the "Board of Agriculture," (No. 250, May 1911) but thoroughly efficient processes, with quite simple implements, are to be found in many text-books which deal with the preservation of food-products. Also, if intended for long keeping, the proportion of sugar to fruit should be increased.

To make the jelly of Roselle, the same process is followed as given for jam; only, when the fruit has been sufficiently cooked to be quite tender, the whole is thrown on a fine sieve, and the calyces, after removal of the seed-bags, are mashed so as to extract the maximum of juice, which is collected below the sieve, and returned to the pot for a further boil, until it is found, on letting fall a few drops of the hot brew on a cool plate, that they jellify. The same proportion of sugar is used as for jam.

An excellent syrup can also be made of Roselle—and an equally excellent wine, somewhat of the nature of a very superior cider. This wine can be made without the addition of yeast and among the recipes given by sundry writers, the following taken from Quentin's "L' art de Conserver les fruits" is simple, and probably as efficient as any:—"In a barrel containing 15 gallons of water "dissolve 10 pounds of white sugar. Pour in the juice of 25 "pounds of calyces. Stirr well and leave to ferment for a couple "of days or until fermentation stops. Pour off the contents "through a filtering bag into another cask. If further fermenta-"tion occurs in the latter, the bung-hole should be covered with a "cloth only. If no fermentation takes place the bung may be "put in."

Wine made in this way is a still wine which improves on keeping.

A yet simpler method, by which the writer has himself obtained a strongly effervescing wine, is the following:—

Fill up a wooden cask or an earthenware jar with well-rinsed calyces after removal of the seed-bags. Press them well in to the brim and pour on top as much water as the cask or jar will take and let stand for 36 to 48 hours. Pour off the liquid over a filter-bag, put in clean white sugar, then bottle in strong champagne bottles, using well-fitting corks previously steeped in boiling water or in alcohol; secure them well with wire, lest the fermentation gases force them out.

The writer has seen in print some rather staggering accounts of the returns of Roselle cultivation. His own records are summed up in the following figures.

Roselle, Hibiscus sabdariffa var altissima also called Jamaica or Red Sorrel.

On a conservative basis, under average conditions, a crop of 120 fruit per bush may be looked forward to in 7 months.

6 whole fruit weigh one ounce; 9½ calyces (divested of seed-bags) weigh one ounce; 120 fruit, the crop off one bush, will therefore weigh 20 ounces.

There are 2,000 bushes in one acre planted 5 × 4 feet; the crop obtainable off one acre will therefore be 2,500 pounds of fruit.

In actual practice, the writer found that 8 pounds of fruit used in the making of jam, jelly, and syrup gave the following output:

2 bottles of Jelly—nett weight of jelly = 26 ounces
1 quart bottle of Syrup—nett weight of syrup = 33 ounces
4 large bottles of Jam—nett weight of jam = 93 ounces

Estimating the value of the jelly at	$0.70
„ „ of the syrup at	.60
„ „ of the jam at	1.80
we arrive at a gross return of	$3.10

for 8 pounds of fruit.

From this figure must be deducted:

5 pounds of sugar at 25 cents .. =	$1.25
Bottles .. .. =	.60
Cost of cultivation, work and firewood =	.20
	$2.05

The nett profit on 8 lbs. of fruit would therefore be $1.05, and on 2,500 lbs., the produce of one acre, $328.

Excepting for the nematodes mentioned above, the Roselle plant, appears to be singularly free from disease; but it is the host of the Red Cotton bug, a red bug with white and black abdominal stripes, which is very common on several of the Malvaceae, and particularly on the Cotton plant. It propagates very quickly and, unless it is kept in check by frequent sprayings and sulphur dustings, it is difficult to get rid of. Fortunately it only feeds on the leaves, not on the fruit; but it soils the latter by its excreta. It is the *Disdercus singulatus*.

The leaves of the Roselle are also quite a good substitute for sorrel, and as such, form a valuable addition to a vegetable menu.

E. Mathieu.

(To be continued.)

A Guide to the Palm Collection in the Botanic Gardens II.

PESTS.

Though not badly attacked as a whole by pests, palms have a number of enemies which have to be dealt with. In view of this fact it is felt that a few words concerning them, together with a few notes for guidance in dealing with them, would be helpful. These pests are practically all insects, being for the most part beetles and their larvae, the larvae of one or two butterflies, grasshoppers, scale, etc. The plants do not seem to suffer much from fungus diseases, in fact up to the present only two cases have come to the notice of the writer, these being on two species of *Cocos* which were attacked by a leaf fungus.

The following is an enumeration of the chief pests so far noted in the Botanic Gardens:—

Insects. (*a*) Beetles.

Rhyncophorus ferrugiens (Red Palm Beetle).
Rhyncophorus sp.
Oryctes Rhinoceros (Rhinoceros Beetle).
Various small beetles and weevils.

(*b*) Chafer.

Cetonica mandarinea.

(*c*) Butterflies.

Erionota Thrax, Larvae of.
Amathusia phidippus (Large Coconut Butterfly) Larvae of.

(*d*) Grasshoppers various.
(*e*) Coccids.
(*f*) Scale.
(*g*) Thrips.

Fungus. One leaf fungus not yet determined.

The above is not a very formidable list when compared with others plants *Hevea brasiliensis* see Gardens Bulletin, ii (1920) 186 for example, and on the whole they are all fairly easily dealt with. The following details are given for general guidance.

1. *Insects.*

(*a*) *Rhyncophorus ferrugiens* (Red Palm Beetle). Attacks the growing bud which is a very vital part in all palms. The eggs are laid in the bud and when hatched the large fleshy grubs burrow into the soft tissue of the bud, often times proving fatal especially to the single-stemmed species. As a rule only large plants are attacked seldom those in pots or tubs. The beetle is 1½ to 2 inches long, black and has red markings.

1. Actinorhytis calapparia, Wendl.
2. Oncosperma filamentosum, Bl.
3. Elaeis guineensis, Jacq.
4. Oreodoxa regia, H.B.K.
5. Ptychoraphis angusta, Becc.,
6. Heterospathe elata, Scheff.,
7. Arenga saccharifera, Labill.,
8. Verschaffeltia splendida, Wendl.
9. Stevensonia grandifolia, Dunc.
10. Hyophorbe amaricaulis, Mart.
11. Hyophorbe Verschaffeltii, Wendl.
12. Ptychosperma McArthuri, Wendl.
13. Euterpe Jenmanii, Wright.
14. Chrysalidocarpus lutescens, Wendl.

Various small Beetles. Under this heading are included various beetles and their larvae which attack the leaf-sheaths, causing the leaves to appear spotty when unfolded and the plant to appear sickly generally.

As a rule, they are in places which are inaccessible to insecticide in the usual way, and more stringent methods have to be adopted in dealing with them. All dead and badly affected sheaths should be removed and all beetles and larvae thus discovered must be destroyed. A good plan is to burn the sheaths straight away. Some reliable insecticide should then be dropped amongst the remaining leaves and allowed to penetrate wherever possible, this will effectually expel those remaining. Care should be taken in choosing the insecticide as it is sometimes necessary to put it in close proximity to tender parts of the plant. Soft soap, or tuba-root powder is suggested for this use.

(*b*) *Cetonica mandarinea.* The larvae of this chafer attack the roots of tub and pot plants. The signs by which they can be detected are a general sickliness in appearance of the attacked plant.

Treatment. The plant should be turned out of its pot or tub and all grubs destroyed. They are easily recognised by their dark, dirty looking bodies and hard brown heads. After this operation has been carried out the plant should be repotted in fresh soil and a clean pot or tub.

(*c*) *Amathusia phidippus* (Large Coconut Butterfly). The larvae of this butterfly attack the leaflets usually of full grown plants, leaving only the midribs. The caterpillar is smooth, bright green with a broad head and two projecting spikes on its tail.

Treatment. The caterpillars should be picked off and destroyed. Afterwards the plants might be sprayed with tuba root insecticide to prevent more depredations.

Erionota Thrax. The larvae of this butterfly attack the leaves of some palms causing them to roll up, after which they proceed to devour them. The caterpillar is about two inches long, pale sea green in colour, covered with a mealy powder.

Treatment. Pick off by hand and burn, afterwards spraying with insecticide as in the preceding case.

(*d*) *Grasshoppers.* These are occasionally troublesome particularly to young plants. The best way of dealing with them is to catch them in a butterfly net or with a stick dipped in bird-lime.

(*e-f*) *Coccids and Scale.* Both of these pests are fairly abundant. They are particularly troublesome to young plants, though by no means confined to them, as often quite large plants are attacked.

Treatment. These must be dealt with by hand. The best way is to sponge them off the infected parts with a soft soap and paraffin solution.

(*g*) *Thrips.* These tiny insects are very troublesome quite spoiling the appearance of the new leaves, giving them a very blotchy appearance.

Treatment. They can be either sprayed or sponged with a soft soap and paraffin solution.

2. *Fungus.*

As previously stated the writer has only seen one case of fungus attack in the Gardens. Both of the plants attacked being members of the genus *Cocos* (*C. plumosa, Lodd.* and *C. flexuosa,* Mart.). They were attacked by a leaf fungus which caused the leaves to become brown and die off. The following measures were taken to deal with the disease.

Treatment. All the dead leaves, infected leaves and parts of leaves were removed and burnt. The plants were then sprayed with Bordeaux mixture. Up to the present the plants seem to have completely recovered and are already sending up new leaves.

Economic Uses.

The economic value of the palms is widely recognised and the palm family as a whole ranks very high in the list of families of economic value. Apart from the valuable industries of copra, rattans, oils, etc. there are many products which are of great local value and are extremely interesting. Some species seem to be invaluable and of these *Cocos nucifera, L.* is an outstanding example.

The following list, it is hoped, will serve to show how valuable palms are in the production of many articles in daily use, as well as in the important industries mentioned above.

The parts of the plant from which they are obtained are also indicated.

Stem and leaves.—Attaps, Fans, Umbrellas, Baskets, Hats, Mats, Brushes, Wax, Arrows, Spears, Fishing-rods, Sandals, Fancy Articles, Fibre, etc.

Bud.—Cabbage, used as a vegetable, to the detriment of the plant unfortunately.

Inflorescence.—Toddy, which is converted into Sugar, Spirit, Vinegar, etc.

Fruit.—Copra, Oil, Food, etc.

Further notes on this important subject will be given with the description of each species.

List of Genera represented in the Botanic Gardens.

The following list is arranged after the classification of Bentham and Hooker in the Genera Plantarum.

The countries from which they have been introduced are also indicated.

Arecineæ.

1. Areca, L. Trop. Asia; Malay Archipelago; East Indies.
2. Pinanga, Bl. India; Malay Archipelago; East Indies; Philippines.
3. Loxococcus, Wendl. and Drude. Ceylon.
4. Actinorhytis, Wendl. Malaya.
5. Archontophoenix, Wendl. and Drude. Australia.

6. Dictyosperma, Wendl. and Drude. Mauritius.
7. Ptychosperma, Labill. Australia; Polynesia.
8. Ptychococcus, Becc. New Guinea.
9. Coleospadix, Becc. New Guinea.
10. Rhopaloblaste, Scheff. Moluccas.
11. Cyrtostachys, Becc. Malay Peninsula.
12. Chrysalidocarpus, Wendl. Madagascar.
13. Oncosperma, Bl. Ceylon; Malaya.
14. Euterpe, Gaertn. West Indies.
15. Ptychoraphis, Becc. Singapore; Nicobar Islands.
16. Oreodoxa, Willd. West Indies; Trop. America.
17. Calyptrocalyx, Bl. Moluccas.
18. Malortiea, Wendl. Trop. America.
19. Heterospathe, Scheff. Amboina.
20. Iguanura, Bl. Malay Peninsula.
21. Stevensonia, Dunc. Seychelles.
22. Verschaffeltia, Wendl. Seychelles.
23. Dypsis, Noronh. Madagascar.
24. Chamædorea, Willd. Mexico.
25. Hyophorbe, Gaertn. Mauritius; Mascarene Islands.
26. Orania, Zippel. Malaya; Philippines; Moluccas.

CARYOTIDEÆ.

27. Wallichia, Roxb. India.
28. Didymosperma, Wendl. and Drude. Malay Peninsula; Java.
29. Arenga, Labill. Formosa; Malay Peninsula; Christmas Islands; Borneo; India.
30. Caryota, L. Trop. Asia; Malaya; Java; Philippines.

PHŒNICEÆ.

31. Phoenix, L. Africa; India; Ceylon; Siam; China.

CORYPHEÆ.

32. Corypha, L. India; Borneo.
33. Sabal, Adans. Southern United States America; West Indies; Trop. America.
34. Teysmannia, R. and Z. Malaya.
35. Acanthorhiza, Wendl. Central America.
36. Copernicia, Mart. Brazil.
37. Licuala, Thunb. India; Malaya; Polynesia; Moluccas.
38. Livistona, Br. Indo-Malayan region; China; Cochin-China; New Guinea; Philippines; Australia.
39. Pholidocarpus, Bl. Malaya.
40. Rhapis, L. China; Japan.
41. Thrinax, L. West Indies.
42. Cocothrinax, Sarg. West Indies.

LEPIDOCARYEÆ.

43. Dæmonorops, Bl. India; Malaya.
44. Calamus, L. India; Ceylon; Malaya; Philippines; East Indies.
45. Korthalsia, Bl. Malaya; Java.

46. Myrialepis, Becc. Malaya.
47. Zalacca, Reinw. Malaya; Java.
48. Metroxylon, Rottb. Malaya; Borneo.

COCOINEÆ.

49. Bactris, Jacq. Brazil; Colombia.
50. Desmoncus, Mart. Brazil.
51. Astrocaryum, Mey. Mexico; Trop. America; South America.
52. Martinezia, R. and P. Venezuela; West Indies.
53. Elæis, Jacq. Africa.
54. Cocos, L. Tropical and Sub-tropical America.
55. Maximiliana, Mart. Brazil.
56. Attalea, H. B. K. Brazil; Peru.
57. Pseudophoenix, Wendl. Florida.
58. Raphia, Beauv. Trop. Africa; Madagascar.

BORASSEÆ.

59. Borassus, L. India; Africa; Malayan Peninsula.
60. Lodoicea, Comm. Seychelles.
61. Latania, Comm. Mauritius.
62. Hyphæne, Gaertn. Africa.

A general description of the Palm family has already been given. It is now proposed to take the individual species separately.

PALMÆ.

Shrubs or trees, solitary or gregarious, armed or unarmed, rarely pubescent. *Stem* erect, scandent or decumbent, rarely branched above. *Leaves* alternate, plaited in bud, pinnatisect or palmate, rarely simple or bipinnate; petiole sheathing. *Flowers* 1 or 2 sexual, small, in panicles or spikes that are enclosed in one or more large sheathing bracts, generally termed spathes, usually 3-bracteate. *Perianth* inferior, segments 6 in two series, sepals and petals, usually all free, imbricate or valvate. *Stamens* 3 or 6 rarely more; anthers versatile. *Ovary* 1—3 celled or of 3 1-celled carpels; stigmas 3, usually sessile; ovules 1—2 in each carpel, adnate to the wall, base or top of the cell, anatropous. *Fruit* a 1—3 celled drupe or hard berry or of 1—3 carpels. *Seeds* erect or laterally attached, rarely pendulous; albumen horny or bony, solid or ruminate.

Genera about 140. Chiefly tropical.
Represented in the Gardens—about 60 genera.

No key to the genera has been inserted owing to its highly technical character. A key to enable visitors to distinguish specimens in the Gardens will be given later.

The descriptions have been kept as simple as possible, but to describe a species accurately without using a fair number of technical expressions is very difficult and would make them very long. Where practicable a key to species has been inserted, based on general characters as much as possible.

1. Areca, L.

Large or small palms either single or many stemmed, erect, ringed by scars of fallen leaves. *Leaves* pinnate. *Inflorescence* produced below the leaves, consisting of spathe and spadix, the former enclosing the latter. *Spadix* branches numerous, slender, terminal portions male, with a few female flowers at the base of each branch. *Male flowers* asymmetric, very small; sepals ovate, small; petals lanceolate often ribbed obliquely; stamens 3 to 6 in number; anthers attached by base. *Female flowers* much larger; sepals ovate, flat with a circular outline; petals slightly longer than sepals; stigmas 3, small; ovule, erect, basal. *Fruit* ovoid-oblong tapering towards each end; stigma terminal. *Seed* ovoid, truncate, that is as though cut off at the end; albumen ruminate.

Species 10, Indo-Malaya and Australia. Represented in Gardens 4.

The four species of *Areca* represented in the Gardens are, with the exception of *A. triandra, Roxb.*, very alike in general appearance. This renders it somewhat difficult to make a key without using much technical detail. However an attempt has been made to separate the species on leaf and fruit characters.

Single stemmed.

Leaflets about 30 pairs, placed fairly closely on the rhachis, fruit ovoid ..	1. *A. Catechu*
Leaflets about 20 pairs, placed fairly widely apart on rhachis, fruit spindle-shaped	2. *A. concinna*
Leaflets about 40 pairs, placed close together on rhachis, fruit obovate ..	3. *A. glandiformis*
Several stemmed	4. *A. triandra*

1. *Areca Catechu*, L. Sp. Pl. 1189. (Pinang or Betel Nut Palm.)

Stem.—Solitary, from 40 to 60 ft. in height when fully grown; diameter 8-12 inches, straight, cylindric, grey, of equal thickness throughout. *Crown* small in comparison with height. *Leaves* 4-6 ft. in length, spreading; leaflets many, 1-2 ft. long, linear, many veined, having 2 to 3 prominent ribs, lower leaflets acuminate, upper præmorse that is as though the end were bitten off, topmost leaflets short and broad. *Sheath*, long, smooth, green. *Spathe* simple, flattened, glabrous, produced below the leaves. *Spadix*, shortly peduncled, 12-18 in. long, branched at the base in a paniculate manner; branches filiform, bearing pendulous male spikes at their extremities. *Male flowers* small, disposed more or less in two rows; sepals 3, very small, and triangular; petals longer, oblong, rigid, marked with fine lines; stamens six. *Female flowers* 1-3 at the bases of the spadix branches or in their axils, larger than the male; sepals $\frac{1}{3}$ in. long, ovate, obtuse; petals longer than sepals. *Fruit* ovoid, orange or scarlet, 1-2 inches long. *Seed* $\frac{3}{4}$ inch in diameter, ovoid.

This palm is much cultivated throughout Trop. Asia, Malaya, etc. Its origin is not known as it is always found as a cultivated plant only.

The fruits are much used by the natives for chewing purposes and impart the red appearance to the lips and teeth when being masticated with betel leaves.

It has certain medicinal properties, and is chiefly used as an astringent and vermifuge. It is also used as a medicine in the treatment of worms in dogs.

There are also two specimens of a yellow form of *Areca Catechu, L.* This form is quite yellowish in appearance and produces yellow fruits. It can be seen in the Palm Valley in close proximity to the other species of *Areca.*

2. *Areca concinna,* Thw. Enum. 328 (1864).

Stem.—Solitary, from 8-12 ft. in height, 1-3 inches in diameter, cylindric, green. *Crown*—Larger than in *A. Catechu. Leaves* 3-3½ feet in length, spreading; leaflets 1½ to 2 feet in length, 2-3 inches broad, lanceolate, sickle shaped, acuminate, almost glabrous, lower simple, one ribbed, upper 2-3 ribbed, topmost pair of pinnae very broad, toothed at the margin. *Sheath* fairly long, up to 18 inches. *Spathe,* flattened. *Spadix* up to 1 foot in length, shortly peduncled, paniculately branched, branches filiform bearing male flowers in pendulous spikes at their extremities, female flowers borne in axils of branches or at their bases. *Male flowers*—arranged in two rows, small; sepals oblong, obtuse; petals nearly three times as long as sepals, obliquely ovate-lanceolate, acuminate, ribbed or striped; stamens 6. *Female flowers* very small; sepals form an unequally lobed cup of very tiny dimensions, petals, ovate oblong, obtuse. *Fruit* 1½ inches long, almost spindle shaped and bearing a protuberance in the centre, scarlet.

Habitat.—Ceylon.

The fruits of this *Areca* are also chewed with betel and are generally obtained from wild specimens. Only small specimens up to about 6 ft. in height are present in the Gardens collection.

3. *Areca glandiformis,* Lam. Encyl. 1. 241.

Stem.—Solitary, up to 40 ft. high, cylindric, annulate, diameter 4 to 6 inches. *Crown* medium. *Leaves* produced at top of stem, 4 to 6 or more feet in length, dark green; leaflets several, reduplicate, that is doubled back at the edges, sub-opposite, 1½ to 2 ft. in length, 1½ to 2 inches broad, linear lanceolate, acuminate, glabrous, green above, slightly glaucous below, nerves several, pale. *Spadix* produced below the leaves, monoecious, pendulous, peduncle about 4 inches long, several branches. *Male flowers* distichous, small; stamens 6. *Female flowers* larger than male; calyx lobes coriaceous, ovate, acute or acuminate, stigmas 3. *Fruit* longly-obovoid, glabrous, cuspidate, olive coloured at first, turning later to red.

Habitat.—Moluccas.

The specimens of this species present in the Gardens are to be found in the Palm Valley. No specimen is at present more than 20 ft. in height.

4. *Areca triandra,* Roxb. Hort. Beng. 68.

Stem.—Soboliferous, producing several strong stems, annulate, internodes fairly wide apart, green, up to 15 ft. in height, diameter 1-1½ inches. *Leaves* 3 to 4 ft. long, spreading, light green; leaflets 1½ to 2 feet long, 1 to 3 inches broad, linear lanceolate, acuminate, upper leaflets confluent producing a broad, præmorse pair of pinnae; nerves 2 or 3 in all but the top pair in which there are up to 7. *Spathe* 1 foot or more in length. *Spadix* shortly peduncled, up to 1 foot in length over all, branches many, paniculate. *Male flowers* small, disposed in two rows; sepals 3, small; petals larger than sepals; stamens 3. *Female flowers* 1-3 at base of branches of spadix or in the axils, larger than male; sepals shorter than petals, small. *Fruit* about the size of an olive, orange coloured eventually scarlet, upwards of 1 inch in length, ¼″ in diameter at middle, ellipsoid, tapering to base, truncate at apex, beaked.

Habitat.—India.

This plant is easily distinguished from the other species of *Areca* in the Gardens collection, on account of its soboliferous habit, the others all being single stemmed. Several specimens may be seen in the Palm Valley, it being quite an ornamental plant.

2. Pinanga, Blume.

Single or many stemmed palms, often producing good strong clumps, varying in height from 2 ft. in some species to 12 ft. or more in others, unarmed. *Stem* erect, annulate. *Leaves* pinnate with the upper leaflets confluent, more rarely entire; leaflets vary in length and breadth fairly considerably in different species. *Inflorescence* produced below the foliage. *Spathe* varying in size from 1 in. to over 1 ft., solitary. *Spadix* branched; flowers arranged distichously or spirally, one female between two males. *Male flowers* symmetric; sepals acute, keeled, not imbricate; petals ovate or lanceolate, valvate; stamens 6 or more; anthers erect, affixed by base. *Female flowers* much smaller, ovoid or globose, sepals and petals orbicular; ovary 1-celled, stigmas 3; ovule basal, erect. *Fruit* drupe, ovoid or elliptic. *Albumen* ruminate.

Species about 50. India, Malay Archipelago.
In the Gardens 7 species.

Dwarf palms—up to 4ft. in height.

- Leaves broad as long .. .. .. 1. *P. disticha*
- Leaves twice as long as broad .. .. 2. *P. subruminata*

Tall palms—up to 10 ft. in height.

- Stems ½ to 1½ inches in diameter.
  - Leaflets numerous .. .. .. 3. *P. malaiana*
  - Leaflets few.
    - Leaflets linear or linear lanceolate 4. *P. riparia*
    - Leaflets sigmoidly lanceolate .. 5. *P. patula*

Stems 2 to 2½ inches in diameter.

Leaflets 7 or 8 pairs	..	..	6. *P. fruticans*
Leaflets 20 to 24 pairs	..	..	7. *P. ternatensis*

1. *Pinanga disticha*, Bl. Rumphia, ii. p. 77 (Pinang Luggong).

Stems several, slender, up to 3 ft. in height, diameter ¼", green. *Leaves* usually simple, divided into 2 lobes, or with a few broad acuminate leaflets, up to 1ft. in length, dark green mottled with yellowish-green patches, nerves prominent, numerous; petiole up to 4 inches in length, scurfy; sheathes short, up to 3 inches. *Spathe* oblong, beaked, about 1 inch in length. *Spadix* solitary, occasionally branched, 1 to 4 inches in length, deflexed, green, peduncle tomentose; flowers distichously arranged. *Male flowers* ⅛ in. long; sepals short, rounded; petals ovate, acuminate; stamens usually 15. *Female flowers* small; sepals orbicular; petals ovate, with sharp rigid point; pistil much longer than petals; stigma capitate. *Fruit* drupe ½ inch in length, ovoid, acute, red. *Seed* elliptic.

Habitat.—Malaya.

This pretty little palm makes a charming pot plant when well grown.

2. *Pinanga subruminata*, Becc. Males. iii. 174.

Stems short, erect, about 2 feet in height, diameter about ⅜ inch, annulate; internodes about 1 inch long. *Leaves* narrowly cuneate, forked, sometimes very deeply, apex truncate, toothed, light green, up to 12 inches in length, 3 to 4 inches wide; nerves numerous and strong; petioles about 2 inches long; sheaths about 2 inches long, ribbed. *Spathe* 3-angled, about 1½ inches in length, more or less oblong, having two horns about ¼ inch in length at the apex. *Spadix* solitary, deflexed, glabrous, up to 4 inches in length, thickening in fruit; flowers distichous or spiral, often opening and producing fruit inside the spathe. *Male flowers* ¼ inch long; sepals acuminate, deltoid; petals linear, narrow; stamens about 12. *Female flowers*, sepals round, spreading; petals erect, orbicular, larger than sepals; pistil conical. *Fruit*, drupe about ½ inch long, elliptic, beaked, red. *Seed* elliptic, subacute.

Habitat.—Malaya.

I have found only one plant of this species, in the Gardens.

3. *Pinanga malaiana*, Scheff. Natuurk. Tijdschr. Nid. Ind. xxxii, 175. (Pinang Dampong).

Stems several, slender, up to 12 ft. in height, diameter 1 inch, internodes about 3 inches long. *Leaves* pinnate, large, from 5 to 8 ft. in length, spreading; leaflets linear acuminate, about 15 inches in length, ½ to 1 inch broad, dark green, glaucous beneath, having 2 prominent nerves; petiole about 18 inches in length. *Spathe* about 10 inches in length, oblong. *Spadix* deflexed, stout, about 12 inches in length; branches 2—5, flattened, red in fruit; flowers arranged in two rows. *Male flowers* flat; sepals lanceolate;

petals much larger; stamens, filaments short. *Female flowers* sepals and petals very short; stigma in form of a disc (discoid). *Fruit,* drupe ¾ inch in length, narrowed at both ends, black when ripe. *Seed* olive-shaped with a truncate apex.
Habitat.—Malaya.

4. *Pinanga riparia,* Ridley, Journ. Roy. As. Soc. Straits Branch, xliv (1905) 201.

Stems several, distant, up to 12 ft. in height, ½ to 1½ inches in diameter, internodes 3-4 inches in length. *Leaves* about 3 ft. long, pinnate; rachis angled, scurfy; leaflets three or four pairs of lateral and one terminal bilobed one, lateral leaflets linear or linear lanceolate, acuminate, with 3 to 6 nerves, 3 to 9 inches in length, 1 to 2 inches broad, terminal leaflet broad, bilobed, many nerved, coarsely toothed. *Spadix* decurved, peduncle stout, about ¾ inch in length, branches 3 or 4, stout, 6 to 7 inches long; flowers distichous, close. *Female flowers* globose, about ⅛ inch in length; sepals and petals very short; stigma in form of a disc. *Fruit,* drupe ¾ inch in length, narrowed at both ends, black when ripe. *Seed* olive-shaped with a truncate apex.

Habitat.—Malaya.

5. *Pinanga patula,* Bl. Rumphia, ii, 86, t. 115.

Stems several, slender, up to 10 ft. in height, diameter ½ to 1 inch, internodes 2½ to 3 inches long. *Leaves* 2 to 3 ft. in length, pinnate; leaflets about 6 pairs, sigmoid, acuminate with a long point, narrowed at the base, terminal leaflet deeply divided, apex toothed, 7 inches in length, 2 to 2½ inches wide, dark green; nerves 3 to 7. *Spadix* 4-branched, deflexed, branches slender about 6 inches long, red in colour. *Male flowers* not seen. *Female flowers* small; sepals orbicular, margins crenulate and appear as though bitten; petals smaller and rounder. *Fruit* drupe, flesh colour, elliptic, ribbed, about ½ inch long. *Seed* elliptic, ruminate.

Habitat.—Malay Peninsula, Sumatra.

This species forms very effective clumps and in common with most *Pinangas* is always very clean stemmed.

6. *Pinanga fruticans,* Ridley, n. sp. MSS.

Stems several, close, light green, annulate, up to 10 ft. in height, diameter 2-2½ inches; internodes 2 to 2½ inches long. Leaves up to 5ft. long, light green; petiole 1 to 1½ ft. long, yellow, scurfy; sheath 1 to 1½ ft. long, very scurfy giving a brownish appearance; leaflets 7 or 8 pairs, 1½ to 2 ft. long, 4 to 5 inches wide, trapeziform acuminate, 5 to 7 nerved, upper 2 pairs of leaflets 9-nerved, very broad, strongly toothed præmorse. *Spathe* boat shaped, reddish, papery, caducous. *Spadix* red, 8 or 9 branched; peduncle ¾″ long, stout; branches up to 9 inches long; flowers distichous. *Male flowers* ¼″ in diameter; sepals ovate acuminate, flesh colour; stamens 12. *Female flowers* smaller than the male, orbicular; sepals ovate acute; stigmas 3. *Fruit* almost round, slightly narrowed at the base, ¼ inch long, at first light green, when ripe quite black.

Habitat.—Java.

Up till quite recently this plant was called *P. Kuhlii,* Bl., but Ridley has now made it a new species. There are several specimens of it in the Gardens. It spreads itself all over the place, and in a shady spot makes a very ornamental plant.

7. *Pinanga ternatensis,* Scheff. Ann. Jard. Buitenz. i (1876) 149.

Stems several, close, green, annulate; internodes 3-4 inches long. *Leaves* 6-8 ft. long, light green; petiole 1-1½ ft. long, yellow, scurfy; sheath 1½ ft. long, very scurfy giving a brownish appearance; leaflets 20-24 pairs, acuminate, 1½-2 ft. long, 1-1½ inches broad, generally 2 ribbed, upper pair of leaflets præmorse, 2 inches broad, strongly nerved, having 6 nerves, next five pairs of leaflets bifid or præmorse, 1″ broad. *Spathe* boat-shaped, brown, caducous. *Spadix* red, 12 branched; peduncle short, 1 inch long, stout; branches 9″ to 1 ft. long. *Male flowers* ¼″ in diameter; petals 3, ovate, acuminate; stamens 18, filaments much shorter than the anthers. *Female flowers* orbicular; sepals ovate, acute. *Fruit* ½ inch long, oblong, truncate at base and apex, at first yellow, when quite ripe black.

Habitat.—Ternate Islands.

This plant is very like *P. fruticans,* Ridley, in appearance, but it has considerably more leaflets, and a more branched spadix.

3. Loxococcus, Wendl. and Drude.

Trunk tall, erect, cylindric, annulate. *Leaves* pinnate; leaflets linear, obliquely truncate, margins of leaves folded back, surface plaited lengthwise. *Spathe* 2, boat shaped. *Spadix* monœcious, that is stamens and pistils in separate flowers on the same inflorescence, branched; flowers in threes, mostly in clusters of a female between two males, spirally arranged around the branches. *Male flowers,* sepals 3, orbicular, imbricate; petals 3, much larger, ovate, valvate; stamens 9-12, filaments very short, anthers subversatile; pistillode, minute, ovoid. *Female flowers* smaller than male, sub-globose, sepals orbicular, broadly imbricate, tips valvate, staminodes 0; ovary 1-celled, stigmas 3, minute, ovule parietal. *Fruit* subglobose, beaked with a sharp rigid point, stigmas terminal, endosperm ruminate. Monotypic.

Species 1, Ceylon. Represented in Gardens 1.

1. *Loxococcus rupicola,* Wendl. and Drude in Linnœa, xxxix, 185.

Stem.—Solitary, erect, up to 40 ft. in height, 4-5 inches in diameter, swollen slightly at base, annulate. *Leaves* spreading 6-8 ft. in length, pinnate; petiole 1-1½ ft. in length, with green smooth base; leaflets 12-20 pairs, up to 2 ft. in length by about 2½ inches in breadth, spreading, somewhat recurved, linear, subglaucous beneath with scattered furfuraceous scales; sheath very short. *Spathe* about 1 ft. long, pale yellow, clothed with reddish scales. *Spadix* produced below the leaves, blood red in colour, about 1 ft. in length, triangular when fully developed; peduncle

short, branches spreading, glabrous; flowers spirally arranged, generally in scattered clusters of 3, males in pairs towards the upper part of the branches, females solitary between 2 males in lower part. *Male flowers* ½ inch in diameter; stamens 12, filaments equalling the anthers. *Female flowers* ovoid with appressed perianth segments. *Fruit* globosely ovoid, about 1 inch in length. *Seed* globose.

Habitat.—Ceylon.

This palm has not yet fruited in the gardens, though it has several times flowered. The plant which is in the Palm Valley is at present about 15 feet in height and is very attractive with its close growing crown of leaves and blood red flower spikes.

F. Flippance.

(*To be continued.*)

Polyembryony.

Two instances of what presumably are cases of polyembryony were recently noticed by Mr. G. B. Deshmukh on germinating seeds in the Economic Gardens.

In one case, that of *Citrus decumana*, L. the Pomelo, one seed bore five shoots each with its own diminutive cotyledon and rootlet. These shoots were separated and planted and have done well.

The other case was a seed of the Avocado Pear, *Persea gratissima, Gaertn.* which gave rise to six shoots and a common root. They were difficult to separate and have been allowed to grow as they arose.

The above seeds took longer to germinate than the normal seeds did, and the first shoots were somewhat weakly in their early stages.

Mr. Deshmukh also reports that at the same time adventitious buds were observed on the leaves of a cabbage.

T. F. C.

Relation of Soil Acidity to Plant Juice.

In Soil Science Vol. VII, No. 6. E. Trong and M. R. Meacham bring to a conclusion their paper on Soil Acidity in its bearing on the acidity of the Plant Juice. In view of the large amount of fruit planting at present contemplated in Malaya the following extract from the above quoted paper should prove of value in influencing planters in their selection of soil.

"There are considerable differences in the acidities of juices of different species of plants. The acidity of each species of plant, while it may vary to an extent easily measurable, is, however, usually limited to a rather narrow range. Undoubtedly for each species of

plant there is a certain acidity which is most favorable for the life processes of that species. Unquestionably in many cases soil acidity, by limiting the supply of lime available for plants, affects the acidity of the juice or protoplasm of these plants. The importance of a proper regulation of plant acidity in relation to vital plant processes should be noted.

"In the life processes of plants, acids are formed, some of which are probably simple by-products. Lime and other bases are needed to neutralise these acids. Plants high in protein are usually high in lime and other bases indicating the formation of acids in protein synthesis. If the supply of lime and other bases is inadequate, the acidity of the plant juice rises to a certain extent which is limited because the accumulation of acids probably decreases the rate of the processes which produce acids. A condition of self regulation thus probably exists and death due to over-acidity is prevented. Slow growth and a weakened condition however, result as is the case with plants of high lime requirement growing on acid soils.

"In plants there are many "buffer" substances which to a certain extent help to maintain a more uniform acidity and prevent rapid and excessive alterations, as would result especially from diurnal changes in plant processes. Bases are however usually needed in the formation of these "buffer" substances."

T. F. C

Red Ring Disease of Coconuts.

The following extracts are taken from a report read by Mr. W. Nowell, D. I. C., Mycologist, Imperial Department of Agriculture, Trinidad on Oct. 16, 1919, and published in the "Agricultural News" Vol. XVIII, No. 460. It is considered it may be of interest to local growers of coconuts.

"It may be remembered that during my last visit I had incidental opportunities of making observations on the so-called root disease of coconuts, and announced the invariable association of the disease in all cases examined, with a minute thread worm or nematode. The matter was not then sufficiently advanced for the issue of a report, and the investigation is still far from complete.

In the first place it must be stated that the connexion of the disease with the nematode worm has been abundantly confirmed. Not only is the worm present in close association with the first appearance of the disease in any organ of the plant, but infection experiments, with material to all appearances pure have resulted in complete and typical infestation of the inoculated trees with the reproduction of all the symptoms of the disease, the parallel controls remaining healthy. The proof cannot be considered absolute, but it comes nearer to certainty than is the case with very many plant diseases in which causation is regarded as established.

"The worm has been described as a new species, *Aphelenchus cocophila*, by Dr. N. A. Cobb, of the United States Department of Agriculture, who has prepared a paper on its characteristics for the forthcoming number of the West Indian Bulletin.

"It is now clear that the existence of the disease in the roots, though fairly general, is only secondary. Examples have been seen in which the roots were affected only in the slightest degree. The centre of infestation is the red zone in the stem, which is simply a vast breeding ground of the worm. From this it extends more or less along the roots, and, what is much more serious in immediate results, to the leaves. This includes not only the mature and semi-mature leaves which progressively fail in the familiar manner, but the very youngest rudimentary leaves, only a few inches long, in the centre of the bud. It appears to be this infestation of the leaves which brings about the death of the tree. In plantations where the trees are uniform in age, the disease typically appears first in widely and thinly scattered cases when the trees approach bearing age. This can occur equally on virgin forest soil or on old cultivated land. The worms may come from some unknown alternative host, not coconut, but the balance of probability seems at present to be with the conclusion that they are introduced with the seed nuts.

"From the centres of infection thus established, the disease extends to surrounding trees, and the resulting losses can be very serious. I have already seen or heard of several instances in which they approached 30 per cent.

"The process of natural infection, and the length of time required for development remain to be investigated. Three trees in Grenada inoculated in the stem 1 to 2 feet from the ground were fully infested and failing in sixty days. A tree inoculated in the stalk of a leaf had a rather general but not fully developed infestation in seventy-four days. A tree in which material was placed among the leaf bases without inoculation was fully infested in stem and leaves in seventy-four days, while a tree similarly treated in one leaf base had seventeen infested leaves at the end of the same period.

"It thus appears that infestation may take place among the leaves without previous injury and this can be conceived as quite possibly occurring from dry infected material blowing about or from worms gaining access to the leaf bases of young trees from the soil. There is a large amount of detail work remaining to be done with regard to the resistance of the worms to dryness and to chemical agents, to their distribution and longevity in the soil and other matters. This work is of an obvious kind, and, given the opportunity there is every prospect of approaching to a fairly complete knowledge of the disease within a reasonably short time.

"It is clear that the only hope of control lies in prevention and not cure and the bigger practical difficulty is going to be the disposition of the vast amount of infested material which the dying trees contain."

T. F. C.

The Poisoning of Birds by Cassia bicapsularis.

The Queensland Agricultural Journal Vol. XII, December, 1919 contains an account of the poisoning of birds by two species of the genus *Cassia* (*Leguminosae*). One of them *Cassia bicapsularis*, Linn., a native of tropical America is not unfrequently introduced into cultivation on account of its rather large masses of bright yellow flowers. Specimens of this plant in the Singapore Gardens' Herbarium were collected on the Race Course Road, Penang, and it is quite possible this species is growing in cultivation or as an escape in other localities.

Mr. White concludes his account with the remarks that "In the cases here quoted, there seems no doubt that the species of *Cassia* referred to could definately be blamed as the cause of the deaths of the birds in each; and it would further seem that the fairly numerous charges of stock poisoning made against various species of *Cassia* in Queensland may be more correct than previously imagined. This, however, is a matter that can only be ascertained by future investigations."

T. F. C.

A New Source of Plant Food.

Under the above somewhat misleading title an article in the "Journal of Heredity" Vol. X, No. 7 draws attention to plants which gather nitrogen and store it after the well known manner of the bacterial nodules of the *Leguminosae* plants. In the present case however the plants are members of the *Rubiaceae* and store the nitrogen in small nodules in the leaves instead of on the roots. The leaf nodules contain colonies of a non-motile, nitrogen bacterium, known as *Myco-bacterium rubiacearum*. The two plants quoted *Psychotria bacteriophila* and *Pavetta Zimmermanniana* are not recorded from Malaya but it is stated that probably other Rubiaceous plants have the same habits. The article continues, "These bacteria almost invariably inhabit the micropyle of the young seed, and, when the latter germinates, grow through certain stomata of the young leaves and into the intra-cellular spaces formed in the leaf-tissues around these stomata. Cavities are formed through the growth of the epidermal cells which later close entirely and make bacterial nodules which are deeply imbedded in the leaf tissues. A single leaf may have several dozen of these symbiotic bacterial nodules. Faber was able, by treating the seeds with hot water and a sublimate solution to kill the inhabiting myco-bacteria, and later, to infect part of the seedlings grown from these seeds with pure cultures of the bacterium. The artificially infected seedlings grown in soil free from combined nitrogen grew well and remained healthy for four months whereas those not so infected turned yellowish-white and died in three or four weeks. The plants from unsterilized seeds produced leaves bearing many more bacterial nodules than did those from sterilized seeds which were later artificially inoculated.

"In view of the fact that these Rubiaceous plants with nodule-bearing leaves occur in many parts of the tropics, and that in India the value of their leaves has long been recognized, and considering the importance of nitrogen-fixing legumes as soil enrichers, the suggestion of Faber that we may have in these trees and shrubs plants of positive agricultural value deserves the serious consideration of tropical planters. If they can be grown as subsidiary crops beneath plantations of rubber, cacao, coffee, or other important tropical cultures, and their leaves allowed to accumulate upon the ground to serve as a mulch and as nitrogenous fertilizer, they may have great value. They differ from the leguminous cover-crops in that they are perennial in habit, and will not need to be replanted every year. It might be possible to prune them severely every year and utilize the clippings as fertilizer. The subject is one which opens up a new field in connection with tropical agriculture, and one which offers remarkable possibilities."

As the Rubiaceae are well represented in this part of the world it will be of interest to ascertain if any local representatives are provided with these leaf nodules.

T. F. C.

Paper.

The sources from which paper pulp can be obtained are continually being discussed especially with a view to seeing what products of tropical forests or open country that are at present wasted can be turned to good account. The results of investigations on bamboos, grasses, etc. are given in Bulletin No. 16 of the Philippine Bureau of Forestry.

The following interesting account of the manufacture of paper pulp from "lalang" or "blady grass" (*Imperata arundinacea*, Cyr.) is taken from the Queensland Agricultural Journal, Vol. XII, November 1919. "It takes three tons of green blady grass to manufacture 1 ton of crude pulp, while it takes, at least, 7 to 8 tons of sugar-cane to make 1 ton of brown sugar. Delivered in the Southern Paper Mill, the pulp is worth, at least, £21 per ton a value equal to that of one ton of sugar. Under present conditions the cost of manufacturing the pulp is greater than that of making sugar, owing chiefly to the fact that chemicals are dear and the machinery and appliances have not been perfected; but Mr. Campbell can show not only how to make good use of local crude alkalis, but, also, how to bring the application of his method up to sugar mill standard, thus greatly decreasing the cost of manufacture. This would mean that a higher price should be paid for the grass—in fact, a price equal to that of sugar cane, say £2 per ton green—making 1 ton of hitherto useless blady grass (considered a pest and a curse by the cane-farmer) growing without cultivation, equal in value to 1 ton of the best cultivated sugar-cane.

"We (Queensland Agricultural Journal) shall be very pleased to hear that Mr. Campbell's experiments achieve such a result, as it would be of exceedingly great value to Australia generally; and would doubtless give rise to an extensive business in Papua, where there are large tracts of land on navigable rivers notably the Kemp Welsh River, covered with a luxuriant growth of this hitherto pest of the planters. And it must not be forgotten that native labour in New Guinea is cheap, plentiful and reliable."

There are no doubt many in Malaya who will also be interested to hear of further results in this direction.

T. F. C.

A Remedy for Bean-Fly.

In the last issue of the Garden's Bulletin page 205, mention was made of a beetle attacking the Lima Beans in the Economic Gardens. Other material was collected and forwarded to the Imperial Bureau of Entomology. In his reply the Director states:—"The fly is *Agromyza phaseoli, Coq.* a widely distributed pest of beans. The beetle belongs to the family Eumolpidae, the species being *Pagria flavopustulata, Baly.*

"With regard to the methods for dealing with bean-fly, the remedies of which I enclose particular have been adopted with success in Australia.

"The action of an appliance for destroying *Agromyza phaseoli* depends upon a habit which this fly has of making a rapid upward flight when disturbed. In its simplest form it consists of a sheet of window glass set in a light wooden frame, with a curtain of calico about 6 in. wide attached to three of its sides, and a pair of wooden handles on the upper side. The under side of the glass is lightly sprinkled with kerosene, which spreads into a thin film over the glass. The frame is then carried over the young bean plants with the open side in front, and about 9 or 10 in. from the ground, the rear part of the glass just clearing the young plants. The advancing sheet of glass passes over the flies before they rise, and as they do so directly upwards, they strike the glass, become saturated with kerosene and die instantly.

"A larger horse-drawn apparatus, constructed on a similar plan, is suitable for larger areas. After about nine days the flies are less destructive, and as they prefer young beans, a good trap may be prepared by sowing a row of beans in the near vicinity 9 or 10 days after the crop is planted.

"The rows of beans should be covered about four days after planting the seed with a light layer of sawdust, which should then be wetted with kerosene emulsion applied with a watering-can. When the plants are in the second leaf, a second dressing with this emulsion should be given. It should be made with 1 lb. ordinary soap dissolved in about 2 gals. of boiling water. When

dissolved, sufficient cold water should be added to make 4 gallons and three-quarter pint of kerosene should be well stirred in. The emulsion must be warm when used and must be kept well stirred.

"In every case it is advisable that the beans should be burned after the crops have been gathered."

T. F. C.

Castor Oil.

The question as to the market possibilities of Castor Oil production from locally grown crops is again the subject of much discussion. "Tropical Life" Vol. XV, No. 12 contains an article in which the problem is considered from a commercial point of view, and from which the following extract is taken. Methods of cultivation are also given. "Taking the American and English figures as a guide, we see then that the price in 1909 was somewhat about 4*s*., and in 1910 in the vicinity of 5*s*. 4*d*. per bushel.

"The cost of production can only be arrived at according to locality; it would be somewhat similar to the cost of producing an acre of maize except that the harvesting is much more expensive. This is accounted for by the fact that the pods do not ripen evenly and the crop has to be gone over several times in order to harvest it. An estimate for producing, harvesting, bagging, and marketing, a 20 bushel crop of castor beans, allowing 10*s*. per annum for rent would not be less than £5 per acre.

"From the above figures farmers will be able to draw their own conclusion as to whether this crop can be considered payable. Furthermore, it may be stated that castor oil plants cannot be grown continuously on the same land for any lengthy period, because the crop exhausts the soil rapidly; so much so that some authorities state that it should be grown only once in five or six years on the same land."

T. F. C.

DEPARTMENTAL NOTICES.

A list of plants which can be purchased at the Botanic Gardens, in Singapore and in Penang, can be had upon application. The same list appears at intervals in the Government Gazette.

The Gardens' Bulletin is published as material becomes available. Its price is fifty cents a copy, post free, or in advance for every volume of twelve numbers, post free:—

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